11.0 DEVELOPMENT OF EFFLUENT LIMITATIONS AND STANDARDS

This chapter presents the proposed effluent limitations guidelines and standards for the landfills point source category. The proposed effluent limitations are based upon the treatment performance of selected wastewater treatment systems at landfill facilities and are presented as monthly and daily maximum concentrations. The following sections discuss the development of the numerical limitations, which include:

- Development of Long Term Averages and Variability Factors
- Best Practicable Control Technology Currently Available (BPT)
- Best Conventional Pollutant Control Technology (BCT)
- Best Available Technology Economically Achievable (BAT)
- New Source Performance Standards (NSPS)
- Pretreatment Standards for Existing Sources (PSES)
- Pretreatment Standards for New Sources (PSNS)

The sections below present a summary of the statistical methodology used in the calculation of effluent limitations. A more detailed explanation can be found in the "Statistical Support Document for Proposed Effluent Limitations Guidelines and Standards for the Landfills Category" (EPA 821-B-97-006).

11.1 Development of Long Term Averages, Variability Factors, and Effluent Limitations

Effluent limitations for each subcategory are based on a combination of long term average effluent values and variability factors that account for variation in treatment performance within a treatment plant over time. The variability factors and long term averages were developed from a database composed of individual daily measurements on treated effluent. EPA collected technology performance data from field sampling efforts and from industry supplied data provided in the Detailed Monitoring Questionnaire. A detailed description of each data source is presented in Chapter 4.

While EPA sampling data typically reflects the daily performance of a system over a 5-day period, industry supplied data (collected through the Detailed Monitoring Questionnaire) reflects up to three years worth of data. The monitoring data obtained through the Detailed Monitoring Questionnaire is unique to each facility in terms of the number of parameters analyzed and monitoring frequency. Several facilities provided information for dozens of pollutants, while others provided data for only a few parameters. Additionally, monitoring may have been performed weekly, monthly, or quarterly. Wherever possible, when calculating effluent limitations, EPA used a combination of industry supplied data and EPA sampling data in order to better account for the variability of leachate over time.

These data were used to develop long term average values and variability factors, by pollutant and technology option, for each subcategory. The proposed limitations were the result of multiplying the long term average value by the appropriate variability factors. The following paragraphs briefly describe how each of these values were determined. The detailed methodology and data is presented in the Statistical Support Document.

11.1.1 Calculation of Long Term Averages

For each pollutant selected for regulation (see Chapter 7), long term average effluent values were calculated for each regulatory option and subcategory. The first step was to select representative facilities from the EPA database for each option. The criteria used in facility selection are explained in Section 11.2. After selecting the facilities that best represent a technology option, EPA reviewed the influent and effluent data supplied for each of the regulated pollutants. Data from facilities that did not supply both influent and effluent data for a given pollutant were not included in the calculation of the of the pollutant's long term average. Facilities which supplied both influent and effluent data, but for which the influent concentrations were considered to be too low to evaluate removals across the treatment system, were also eliminated. In addition, for each of the regulated pollutants, all of the selected facilities were analyzed to determine if the facility was utilizing treatment technologies, apart from those selected as the technology option, that may provide significant removals of that particular pollutant. For example, the data from a facility that employed carbon adsorption (a treatment technology which was not part of a selected technology option) would not be used in the calculation of the limit for a pollutant which may be treated by carbon. However, if an intermediate data point which preceded the carbon adsorption treatment were available for this facility, then EPA did consider the use of that data point to characterize the performance of the treatment system up to that point. In addition to the editing criteria outlined above, observations below the sample-specific detection level were set equal to the detection level for the purposes of calculating a facility-level long term average. Furthermore, the EPA sampling data were also edited according to the criteria outlined in Chapter 4, Section 4.9.

Once the facilities and effluent data points were selected, EPA calculated the average effluent concentration for each regulated pollutant at each facility. For facilities in which EPA had data from both week-long EPA sampling and industry supplied Detailed Monitoring Questionnaires (representing data collected over the course of at least a year), long term averages were calculated separately as long as the dates for the two data sets did not overlap. Therefore, by using both data sets, the long term average accounted for the variability of leachate over a longer period of time.

The long term average of each regulated pollutant was estimated for each facility data set by the expected value of the pollutant's daily concentrations. The expected value was based on fitting a modified delta-lognormal distribution to the daily concentration data. The modified delta-lognormal distribution models the data as a mixture of non-detect observations and measured values that follow a lognormal distribution. This distribution was selected because: (1) the data for many analytes consisted of a mixture of non-detects and measured values that were approximately lognormal; and (2) in cases where there are no non-detects, the distribution is equivalent to the usual two parameter lognormal. This is the same basic distributional model used by EPA in the final rulemakings for the Organic Chemicals, Plastics and Synthetic Fibers (OCPSF; 40 CFR Part 414) and the Pulp and Paper category (40 CFR Part 430) and for the proposed rulemaking for the Centralized Waste Treatment industrial category (proposed 40 CFR Part 437, 60 FR 5464 January 27, 1995). In the Pulp and Paper and the Centralized Waste Treatment studies, the modified delta-lognormal distribution assumes that all non-detects have a value equal to the reported sample-specific detection levels and that the detected values follow a lognormal distribution. This model was used as the basis of estimates of the long term average (mean) at a landfill facility. In the case of the OCPSF rule, the same basic model was used but the reported non-detect values were set equal to the pollutant analytical minimum level. A more detailed discussion of the modified delta-lognormal distribution can be found in the "Statistical Support Document for Proposed Effluent Limitations Guidelines and Standards for the Landfills Category" (EPA 821-B-97-006) (EPA 821-B-97-006).

After the facility level long term averages were developed for each regulated pollutant using the criteria outlined above, data from the selected facilities were combined into subcategory-specific long term averages for each regulated pollutant by finding the median of the facility-level long term averages. This median of the facility-level long term averages for each regulated pollutant was the long term average used in the calculation of the effluent limitation as described later in this section.

11.1.2 Calculation of Variability Factors

EPA calculated variability factors using the same data sets used to derive the long term average values. As with the calculation of the long term averages, a modified delta-lognormal distribution was fitted to daily concentration data. Separate variability factors were calculated for different averaging periods and applied only to the corresponding period. Thus, different variability factors are applied to daily data (single measurements without averaging), and to a monthly average based on four measurements taken once per week ("4-day averages") or 20 measurements taken once each day of the work week throughout a month ("20-day average").

For those facility data sets that had at least four observations for a given regulated pollutant, including two detected values, the modified delta-lognormal model was used to estimate daily and 4-day or 20-day average variability factors. There were several instances where variability factors could not be calculated from the landfills database because fewer than two samples were measured above the detection limit. In these cases, variability factors were transferred from biological treatment systems used in the final rulemaking of the OCPSF guideline (40 CFR Part 414).

As stated above, in calculating the variability factors, EPA assumed a log-normal distribution of the data. In addition, the Agency used:

- The 95th percentile to establish the maximum monthly average.
- The 99th percentile to establish the maximum for any one day.

The daily variability factor is defined as the ratio of the estimated 99th percentile of the distribution of daily values to the estimated mean of the distribution. Similarly, the monthly variability factor is defined as the estimated 95th percentile of the distribution of 4-day or 20-day averages divided by the estimated mean of the monthly averages. A monthly average and daily maximum variability factor was derived for each pollutant and for each regulatory option. For each subcategory, the daily variability factor for each pollutant was defined to be the average of the facility-level daily variability factors; the 4-day average variability factors for each pollutant was defined to be the average of the facility-level 4-day average variability factors; and the 20-day average variability factors for each pollutant was defined to be the average of the facility-level 20-day average variability factors.

11.1.3 Calculation of Effluent Limitations

The median long term averages and the average variability factors were used in the calculation of the effluent limitations. For each subcategory, the daily-maximum limitations were calculated by multiplying the median of the long term average for a given pollutant by the average daily variability factor for that pollutant, and the monthly maximum limitations were calculated by multiplying the median long term average for a given pollutant by the average 4-day or 20-day variability factors for that pollutant. Twenty-day average limitations were chosen for the conventional pollutants BOD_5 and TSS, and four-day average limitations were chosen for other nonconventional and toxic pollutants.

11.2 Best Practicable Control Technology Currently Available (BPT)

EPA proposes BPT effluent limitations for the Subtitle D Non-Hazardous and Subtitle C Hazardous subcategories. The proposed BPT effluent limitations would control identified conventional, toxic, and nonconventional pollutants when discharged from landfill facilities to surface waters of the U.S. Generally, EPA determines BPT effluent levels based on the average of the best existing performance by facilities of various sizes, ages, and unit processes within an industrial category or subcategory. In industrial categories where present practices are uniformly inadequate, however, EPA may determine that BPT requires higher levels of control than any currently in place if the technology to achieve those levels can be practicably applied. BPT may be transferred from a different category or subcategory. BPT normally focuses on end-of-process treatment rather than process changes or internal controls, except when these technologies are common industry practice.

In addition, the Clean Water Act (CWA) Section 304(b)(1)(B) requires a cost reasonableness assessment for BPT limitations. In determining the BPT limits, EPA must consider the total cost of treatment technologies in relation to the effluent reduction benefits achieved. This inquiry does not limit EPA's broad discretion to adopt BPT limitations that are achievable with available technology unless the required additional reductions are "wholly out of proportion to the costs of achieving such marginal level of reduction." A Legislative History of the Water Pollution Control Act Amendments of 1972, p. 170. Moreover, the inquiry does not require the Agency to quantify benefits in monetary terms. See e.g. *American Iron and Steel Institute* v. *EPA*, 526 F. 2d 1027 (3rd Cir., 1975).

In balancing costs against the benefits of effluent reduction, EPA considers the volume and nature of expected discharges after application of BPT, the general environmental effects of pollutants, and the cost and economic impacts of the required level of pollution control. In developing guidelines, the Act does not require or permit consideration of water quality problems attributable to particular point sources, or water quality improvements in particular bodies of water. Therefore, EPA has not considered these factors in developing the proposed limitations. See *Weyerhaeuser Company* v. *Costle*, 590 F. 2d 1011 (D.C. Cir. 1978).

In setting BPT standards based on a treatment technology, EPA does not require the use of that technology to treat landfill wastewater. Rather, in order to establish the proposed limits, EPA has demonstrated that the concentration limits are achievable based on a well-operated system using the proposed technologies. The technologies which may be used to treat wastewater is left entirely to the discretion of the individual landfill operator, as long as the numerical discharge limits are achieved.

11.2.1 BPT Technology Options for the Subtitle D Non-Hazardous Subcategory

In the Agency's engineering assessment of the best practicable control technology currently available for treatment of wastewaters from landfills, EPA first considered three technologies commonly in use by the Landfills industry and other industries as options for BPT. These technology options were chemical precipitation, biological treatment, and multimedia filtration. EPA removed chemical precipitation from further consideration as a BPT treatment option for the following reason. While chemical precipitation is an effective treatment technology for the removal of metals, non-hazardous landfills were typically found to have low concentrations of metals in the untreated wastewaters. Observed metals concentrations were not typically found at levels that would inhibit biological treatment, or that would be effectively removed by a chemical precipitation system.

Based upon data collected by EPA, eleven percent of the direct discharging landfills in the Non-Hazardous subcategory employ some form of chemical precipitation, and only eight percent utilize a combination of chemical precipitation and biological treatment. Several of these facilities were contacted by EPA to ascertain the basis for installing chemical precipitation treatment. Based upon the results of this survey, it was determined that chemical precipitation systems generally are not utilized to remove metals that may cause inhibition to the biological treatment system. EPA found that these systems were installed either to: 1) ensure compliance with limitations in their current NPDES discharge permit for selected nonconventional metals, such as iron, that are a water quality concern, or 2) to anticipate metals concentrations that were expected prior to obtaining site-specific leachate characteristics.

EPA sampling data collected at facilities in the Non-Hazardous subcategory showed relatively low levels (less than 1 mg/l) of pollutant of interest metals in untreated landfill generated wastewaters. Furthermore, Table 11-1 presents several sources of performance data for metals removals in activated sludge systems along with published biological treatment inhibition ranges and raw wastewater characteristics from the non-hazardous facilities in the EPA database. Performance data for metals from biological treatment systems were obtained from the National Risk Management Research Laboratory (NRMRL) Treatability Database (formerly called the Risk Reduction Engineering Laboratory (RREL) Treatability Database), the 50-POTW (publicly owned treatment works) Study, and a sampling program conducted at twelve OCPSF facilities that have biological treatment systems. Metal concentrations as found in the raw wastewater for this subcategory are below, or close to, the published inhibition levels for biological treatment systems. A review of performance data indicates that certain pollutant of interest metals, such as chromium and zinc, are removed by the biological treatment process at relatively high rates.

Based upon an analysis of these data, EPA concluded that pollutant of interest metals observed in the Non-Hazardous subcategory generally are present in landfill generated wastewaters at levels that should not effect the operation and performance of a biological treatment system. Under these circumstances, biological treatment removes certain metals identified as pollutants of interest in the Non-Hazardous subcategory. Therefore, EPA concluded that biological treatment is an adequate BPT control technology for certain pollutant of interest metals in the Non-Hazardous subcategory.

Based upon the above assessment, EPA developed the following BPT regulatory options. These two technology options are discussed in detail in Chapter 8 and cost estimates developed for these options are discussed in Chapter 9.

<u>Non-Hazardous Subcategory Option I: Biological Treatment</u>

EPA first assessed the pollutant removal performance of equalization and biological treatment. EPA selected this as Option I due to its effectiveness in removing the large organic loads commonly associated with leachate. BPT Option I consists of aerated equalization followed by biological treatment, and included chemically assisted secondary clarification and sludge dewatering. Various types of biological treatment such as activated sludge, sequential batch reactors, aerated lagoons, and anaerobic and aerobic biological towers or fixed film reactors were included in the calculation of limits for this option. The costing for Option I was based on the cost of aerated equalization followed by an extended aeration activated sludge system with secondary clarification and sludge dewatering. Figure 11-1 presents a flow diagram of the treatment system costed for Option I. Approximately 30 percent of the direct discharging non-hazardous facilities employed some form of biological treatment, and 13 percent had a combination of equalization and biological treatment.

Non-Hazardous Subcategory Option II: Biological Treatment and Multimedia Filtration

The second technology option considered for BPT treatment of non-hazardous landfill wastewater was equalization prior to biological treatment with secondary clarification followed by multimedia filtration. Approximately ten percent of the direct discharging non-hazardous facilities used the technology described in Option II. Cost estimates for Option II were based on the cost of Option I plus a multimedia filtration system. Figure 11-2 presents a flow diagram of the treatment system costed for this option.

EPA selected Option II, equalization prior to biological treatment with secondary clarification followed by multimedia filtration, as the technology basis for BPT limitations for the Non-Hazardous landfills subcategory. EPA proposes to base the BPT effluent limitations on Option II because of the ability of the biological system to control the organic loadings and because of the filtration system's effectiveness for removal of the TSS that may remain after biological treatment. EPA's decision to base BPT limitations on Option II treatment primarily reflects two factors: the degree of effluent reductions attainable and the total cost of the proposed treatment technologies in relation to the effluent reductions achieved. In assessing BPT, EPA considered the age, size, process, other engineering factors, and non-water quality impacts pertinent to the facilities treating wastes in this subcategory. No basis could be found for identifying different BPT limitations based on age, size, process or other engineering factors. Neither the age nor the size of the landfill facility will directly affect the treatability of the landfill wastewaters. For the non-hazardous landfills, the most pertinent factors for establishing the limitations are costs of treatment and the level of effluent reductions obtainable.

EPA has selected Option II based on the comparison of the two options in terms of total costs of achieving the effluent reductions, pounds of pollutant removals, economic impacts, and general environmental effects of the reduced pollutant discharges. BPT Option II removed significantly more pounds of conventional pollutants than Option I with only a moderate, associated cost increase. It is estimated that BPT Option II will cost $1.8 million (1992 dollars) annually more than BPT Option I for an additional removal of 130,000 pounds of conventional pollutants (TSS).

Finally, EPA also looked at the costs of both options to determine the economic impact that this proposal would have on the Landfills industry. EPA's assessment showed that under either option only three facilities would incur significant economic impacts. For this assessment, EPA defined significant economic impacts in two different ways, depending on the ownership of the facility. For privately-owned facilities, significant economic impacts exist when the ratio of the annualized compliance costs to revenue is greater than five percent. For municipally-owned facilities, significant economic impacts occur when the ratio of compliance costs to median household income are greater than one percent. The economic assessment for this proposal is described in the "Economic and Cost-Effectiveness Analysis for Proposed Effluent Limitations Guidelines and Standards for the Landfills Category" (EPA 821-B-97-005).

11.2.2 BPT Limits for the Subtitle D Non-Hazardous Subcategory

The proposed BPT effluent limitations for the Non-Hazardous subcategory are based upon the average of the best existing wastewater treatment systems. The first criterion used in the selection of the average of the best facilities was effective treatment of BOD_5. In selecting BPT facilities, EPA identified facilities that employed either Option I or Option II technologies. Even though Option II technologies were selected as the basis for developing the BPT effluent limitations, it was assumed that very little BOD_5 removal would occur over the multimedia filter employed in Option II, and therefore, facilities employing biological treatment only (Option I) could achieve good removal of

BOD_5 and be considered BPT. However, in determining the BPT effluent limitations for TSS, the data from the best performers using BPT Option II technology were used because of the multimedia filtration system's effectiveness in removing suspended solids.

There were 45 municipal facilities (see Table 11-2) in the EPA database in the Non-Hazardous subcategory that utilized some form of biological treatment considered for BPT. Even though the Non-Hazardous subcategory is comprised of both Subtitle D municipal solid waste landfills and non-municipal solid waste landfills, only municipal solid waste facilities were considered for selection as BPT for the Non-Hazardous subcategory because the wastewaters at these landfills tend to contain a wider array of pollutants than those found at Subtitle D non-municipal facilities. The pollutants found at the non-municipal facilities tended to be a subset of the pollutants found at the municipal facilities. In fact, nine out of the ten pollutants of interest for non-municipal facilities were also pollutants of interest for the municipal facilities (see Chapter 7). The only pollutant of interest present at Subtitle D non-municipal landfills but not at municipal solid waste landfills was MCPA. The remainder of the pollutants of interest present at non-municipal facilities were all found at concentrations similar to, or less than, the concentrations typically found at municipal facilities. Therefore, EPA determined that a treatment system that can adequately control pollutant discharges from a municipal solid waste landfill should also be able to control discharges at Subtitle D non-municipal landfills.

In addition to the 45 non-hazardous municipal facilities identified as potential BPT, EPA also evaluated one hazardous facility (16041) in the EPA database. This facility used biological treatment in the form of a sequential batch reactor (SBR) to treat its landfill generated wastewater. Leachate from both non-hazardous and hazardous landfills was commingled prior to treatment by the SBR at this facility. In determining whether it was reasonable to include a facility from the Hazardous subcategory as a potential BPT facility in the Non-Hazardous subcategory, EPA analyzed two different factors. First, since the facility accepted leachate from both hazardous and non-hazardous landfills, the waste stream was found to contain almost all of the pollutants of interest for the Non-Hazardous subcategory at similar concentrations to those found in the non-hazardous landfill raw wastewater database (see Table 11-3). At this facility, only one of the 33 pollutants of interest for the Non-Hazardous subcategory was not detected in the influent concentration (1,4-dioxane) and four others (barium, disulfoton, hexavalent chromium, and n,n-dimethylformamide) were not included in the analytical effort. Therefore, the Agency determined that the raw wastewater concentrations for the non-hazardous pollutants of interest from this hazardous facility were similar to those concentrations found at the non-hazardous facilities. Second, the facility achieved good BOD_5 removal using biological treatment equivalent to BPT Option I. Therefore, a treatment system that can adequately control pollutant discharges from a hazardous landfill should also be able to control discharges at non-hazardous landfills.

Based on the assessment above, there were 46 in-scope landfill facilities in the EPA database that employed various forms of biological treatment considered for BPT for the Non-Hazardous subcategory. These 46 landfill facilities selected as potential BPT candidates were evaluated to determine the performance across the various types of biological treatment systems. In order to determine the best performers for biological treatment a number of criteria were established. The first criterion used in the selection of the best facilities was effective treatment of BOD_5. Under this criterion, there were several reasons why a facility might be eliminated from the selection of BPT facilities.

Of the 46 facilities treating their wastewaters with some form of biological treatment, only 25 facilities provided BOD_5 effluent data. These data were used to evaluate treatment performance across the various biological systems. Table 11-4 lists those facilities that did not supply BOD_5 effluent data and therefore were eliminated from further consideration as BPT facilities. Table 11-5 lists the candidate BPT facilities that did provide BOD_5 effluent data along with the treatment in place at the facility, the average daily flow, and the BOD_5 and TSS influent and effluent concentrations.

Because BPT is based on the effectiveness of biological treatment, facilities that used additional forms of treatment for BOD_5 (other than biological treatment) were eliminated. EPA, therefore, removed two sites (16099, 16125) using carbon treatment in addition to biological treatment from the list of candidate BPT facilities. EPA eliminated another facility from consideration (16117) because it used two separate treatment trains in treating its wastewater, one with biological treatment and the other with chemical precipitation, before commingling the streams at the effluent sample point. After the elimination of these three facilities, 22 potential BPT facilities remained in the EPA non-hazardous landfill database.

To ensure that the facilities were operating effective biological treatment systems, EPA first evaluated influent concentrations of BOD_5 entering the treatment system. Three facilities (16077, 16093, 16097) had average influent BOD_5 concentrations below 55 mg/l, and were not considered for BPT because the influent concentration was considered to be too low to evaluate removals across the treatment system. Seven other facilities (16048, 16052, 16065, 16161, 16164, 16171, 16176) did not supply BOD_5 influent data and were eliminated from the BPT list. Two facilities (16127, 16129) also were dropped because raw wastewater streams consisted primarily of storm water or groundwater which were considered dilution flows.

The next requirement for BPT selection in the Non-Hazardous landfill subcategory was that the biological treatment system at the facility had to achieve a BOD_5 effluent concentration less than 50 mg/l. Facilities not able to maintain an effluent concentration below 50 mg/l were not considered to be operating their biological system effectively. Three of the remaining 10 facilities (16088, 16165, 16170) did not achieve a BOD_5 effluent concentration of less than 50 mg/l, thus leaving seven facilities in the database. The site identification numbers for the seven facilities selected as BPT were 16041, 16058, 16118, 16120, 16122, 16132, and 16253.

The seven facilities that met all of the BPT criteria employed various types of biological treatment systems including activated sludge, a sequential batch reactor, aerobic and anaerobic biological towers or fixed film, and aerated ponds or lagoons. Most of the facilities employed equalization tanks in addition to the biological treatment while several facilities also included chemical precipitation and neutralization in their treatment systems. The biological systems were followed by a clarification or sedimentation stage. All seven facilities employing well-operated biological treatment systems were used to calculate the effluent limitations for BOD_5. The average BOD_5 influent concentrations to these seven treatment systems ranged from 150 mg/l to 7,600 mg/l, and as mentioned above, all of the average effluent concentrations for these seven facilities were below 50 mg/l.

EPA used the data from the seven facilities identified as having good biological treatment systems to calculate the limits for additional pollutant parameters, including alpha terpineol, ammonia, benzoic acid, p-cresol, phenol, toluene, and zinc. The methodology used in selecting the pollutants to regulate is discussed in Chapter 7. Because one facility employed air stripping (16120), EPA did not use its data for determining the proposed limit for ammonia or toluene. Many of the facilities selected as BPT did not provide data for all the pollutants identified for regulation by EPA. In these cases, EPA based the limits on the BPT facilities for which data was available.

While the BOD_5 edits discussed above ensure good biological treatment and a basic level of TSS removal, treatment facilities meeting this level may not necessarily be operated for optimal control of TSS. To ensure that the TSS database for setting limitations reflects proper control, additional editing criteria for TSS were established.

Two criteria were used for editing TSS performance data. The primary factor in addition to achieving the BOD_5 criteria cited above was that the facility had to employ technology sufficient to ensure adequate control of TSS, that is, a sand or multimedia filtration system. Three of the seven well-operated biological systems (16120, 16122, 16253) used a sand or multimedia filtration system as a polishing step for additional control of suspended solids prior to discharge.

The second factor EPA considered was whether the treatment system achieved an effluent TSS concentration less than or equal to 100 mg/l. Treatment facilities meeting these criteria were included among the average best existing performers for TSS. One of the three facilities (16122) had additional treatment for TSS prior to the filter and was therefore eliminated from consideration in the determination of the TSS limits. The remaining two facilities (16120 and 16253) had TSS effluent concentrations well below 100 mg/l, and thus EPA concluded that they should be included among the average best existing performers for TSS. All of the estimated costs were based on a facility installing aerated equalization tanks followed by an activated sludge biological system with clarification and a multimedia filter and included a sludge dewatering system.

Tables 11-6 and 11-7 present the national estimates of the pollutant of interest reductions for both the BPT and BAT options for municipal solid waste Subtitle D landfills and non-municipal Subtitle D landfills. Table 11-8 and Table 11-9 summarize the estimated amount of pollutants discharged annually from direct discharging municipal landfills and direct discharging non-municipal landfills, respectively, before and after the implementation of BPT for the Non-Hazardous subcategory. EPA's proposed BPT limitations for the Non-Hazardous subcategory are presented in Table 11-10.

EPA estimates that the implementation of the proposed BPT effluent limitations will require a capital cost of $18.8 million and annual operating cost of $5.7 million resulting in a total annualized cost of $7.9 million (post-tax) for the Subtitle D Non-Hazardous subcategory (1992 dollars).

11.2.3 BPT Technology Options for the Subtitle C Hazardous Subcategory

EPA’s survey of the hazardous landfills industry identified no in-scope respondents who discharge directly to surface water. All of the hazardous landfills responding to EPA’s survey are either indirect, zero or alternative dischargers. Consequently, EPA could not evaluate any treatment systems in-place at direct discharging hazardous landfills for establishing BPT effluent limitations. Therefore, to develop effluent limitations based on treatment technologies in use in the Landfills industry, EPA relied on information and data from treatment technologies in use at hazardous landfill facilities discharging indirectly and at non-hazardous landfills discharging directly, a method referred to as “technology transfer”. While EPA has not identified any hazardous landfills discharging directly to surface waters, the Agency is proposing to establish BPT effluent limitations for direct discharges from hazardous landfills because there may be direct discharging facilities that were not included in EPA’s survey of the industry. Also, facilities that are currently zero or alternative dischargers or are currently discharging to a POTW might be granted permits to discharge wastewater directly to surface water in the future.

EPA considered three potential technology options for establishing BPT effluent limitations for the Hazardous subcategory. These technology options were chemical precipitation, biological treatment, and zero or alternative discharge. EPA evaluated chemical precipitation as a treatment technology because of metals concentrations typically found in hazardous landfill leachate and the efficient metals removals achieved through chemical precipitation. EPA also evaluated biological treatment as an appropriate technology because of its ability to remove organic loads present in the leachate. Finally, EPA considered a zero or alternative discharge option as a potential BPT requirement because a significant segment of the industry is currently not discharging wastewaters. The zero or alternative discharge, or alternative disposal option, would require facilities to dispose of their wastewater in a manner that would not result in wastewater discharge directly to a surface water or indirectly to a POTW.

Currently, EPA estimates that 141 hazardous landfill facilities in the United States are zero or alternative dischargers. Methods of achieving zero or alternative discharge currently in use by hazardous landfills are deep well injection, solidification, and contract hauling of wastewater to a Centralized Waste Treatment (CWT) facility or to an off-site landfill wastewater treatment facility. Thirty seven facilities are estimated to underground inject landfill wastewaters on site, 103 facilities send their wastewater to a CWT facility or off-site landfill treatment system, and one facility solidifies wastewater.

EPA analyzed the zero or alternative discharge facilities in the Hazardous subcategory to determine if it was a viable option for direct discharging hazardous landfills. First, the Agency examined underground injection as an alternative disposal option. Underground injection is a demonstrated alternative disposal option in the Landfills industry and was found to be in use at facilities with both large and small wastewater flows. However, this is not considered a viable option because it is prohibited in many geographic regions of the country where landfills may be located. The second widely used disposal option involves contract hauling landfill wastewater to a CWT facility. EPA's survey demonstrated that only landfills with relatively low flows (under 500 gpd) contract haul their wastewater to a CWT facility. The costs of contract hauling are directly proportional to the volume and distance over which the wastewater must be transported, generally making it excessively costly to send large wastewater flows to a CWT facility, particularly if it is not located nearby. Since only one of the 141 zero discharging hazardous facilities solidified their wastewater, EPA did not consider solidification a demonstrated alternative disposal option, especially for facilities with large flows.

EPA evaluated the cost of all hazardous landfills achieving zero or alternative discharge status and determined that the costs were wholly disproportionate to the benefits potentially achieved by this option. To calculate costs for this option, EPA assumed that all facilities currently discharging to a POTW would have to contract haul wastewater approximately 500 miles to a CWT facility. EPA based cost estimates on a $0.35 per gallon disposal cost at a CWT facility, and $3.00 per loaded mile for transport. EPA estimated the total cost to the industry at approximately $30 million dollars.

Based on the characteristics of hazardous landfill leachate and on an evaluation of appropriate technology options, the Agency selected aerated equalization, chemical precipitation and biological treatment followed by secondary clarification as BPT technology for the Hazardous subcategory.

Hazardous Subcategory Option I: Chemical Precipitation and Biological Treatment

EPA selected this as an option based on the effectiveness of biological treatment systems in removing the large organic loads commonly associated with leachate. Metals in the raw wastewater will be removed prior to the biological treatment system using chemical precipitation. BPT Option I for the Hazardous subcategory consists of aerated equalization followed by chemical precipitation and then biological treatment. Cost estimates for this option were based on the cost of aerated equalization followed by a hydroxide precipitation system (consisting of a chemical feed system, flocculation tank and sedimentation), then an extended aeration activated sludge system with secondary clarification and sludge dewatering. Figure 11-3 presents a flow diagram of the treatment system for this option.

EPA relied on data from two facilities employing variations of this technology to calculate the proposed BPT limits for toxic pollutants. One facility employed a chemical precipitation unit followed by an activated sludge system with secondary clarification. The second facility used a sequential batch reactor which was able to achieve good metals removals. Both of these systems were indirect dischargers, as stated above. In the case of BPT regulation for conventional pollutants and ammonia, EPA concluded that establishing limits based on indirect discharging treatment systems was not appropriate because indirect discharging treatment systems are generally not operated for optimal control of conventional pollutants because they are amenable to treatment in a POTW. Therefore, in establishing limits for BOD_5, TSS, and ammonia, EPA established BPT limitations equal to those established for BPT in the Non-Hazardous landfills subcategory.

11.2.4 BPT Limits for the Subtitle C Hazardous Subcategory

The proposed BPT effluent limitations for the Hazardous subcategory are based upon the average of the best existing landfills. Based on the characteristics of hazardous landfill leachate and on an evaluation of appropriate technology options, the Agency selected aerated equalization, chemical precipitation, and biological treatment followed by secondary clarification as BPT technology for the Hazardous subcategory. As previously mentioned, there were no direct discharging hazardous facilities in the EPA database, and therefore, the Agency could not select any treatment systems in place at direct discharging landfills for establishing BPT effluent limitations. Consequently, EPA relied on information and data from treatment technologies in use at hazardous indirect discharging facilities and at non-hazardous direct discharging facilities. Apart from the 141 hazardous, zero or alternative discharge facilities estimated to be in the U.S. based on the responses to the Detailed Questionnaire, EPA identified only three other hazardous respondents to the Detailed Questionnaire all of which discharged indirectly to POTWs.

The leachate from one of the three indirect discharging facilities was very dilute and required only minimal treatment prior to discharge. This facility was determined not to be one of the best performers in the industry. The two remaining facilities both had extensive treatment systems in place and were selected as the best performers for the subcategory. The treatment at one facility consisted of equalization and a chemical precipitation unit followed by an activated sludge system with secondary clarification; the other facility utilized equalization tanks and a sequential batch reactor. Data from these two hazardous facilities selected as BPT were used in the calculation of the effluent limitations for the nonconventional and toxic pollutant parameters including: alpha- terpineol, aniline, arsenic, benzene, benzoic acid, chromium, naphthalene, p-cresol, phenol, pyridine, toluene, and zinc. The methodology used in selecting the pollutants to regulate is described in Chapter 7. As stated above, for BPT regulation of BOD_5, TSS, and ammonia, EPA concluded that establishing limits based on indirect discharging treatment systems was not appropriate because indirect discharging treatment systems are generally not operated to control conventional pollutants because they are amenable to treatment in a POTW. Therefore, in establishing limits for conventional pollutants and ammonia, EPA established BPT limitations equal to those established for non-hazardous landfills. EPA's proposed BPT limitations for the Hazardous subcategory are presented in Table 11-11.

Since there are no direct discharging hazardous landfills in the EPA database, pollutant reductions as a result of the regulation and the average facility costs for implementation of the regulation could not be estimated.

11.3 Best Conventional Pollutant Control Technology (BCT)

BCT limitations control the discharge of conventional pollutants from direct dischargers. Conventional pollutants include BOD, TSS, oil and grease, and pH. BCT is not an additional limitation, but rather replaces BAT for the control of conventional pollutants. To develop BCT limitations, EPA conducts a cost reasonableness evaluation, which consists of a two-part cost test: 1) the POTW test, and 2) the industry cost-effectiveness test.

In the POTW test, EPA calculates the cost per pound of conventional pollutants removed by industrial dischargers in upgrading from BPT to a BCT candidate technology and then compares this to the cost per pound of conventional pollutants removed in upgrading POTWs from secondary to tertiary treatment. The upgrade cost to industry, which is represented in dollars per pound of conventional pollutants removed, must be less than the POTW benchmark of $0.25 per pound (in

1976 dollars). In the industry cost-effectiveness test, the ratio of the incremental BPT to BCT cost, divided by the BPT cost for the industry, must be less that 1.29 (i.e. the cost increase must be less than 29 percent).

EPA is proposing to establish effluent limitations guidelines and standards equivalent to the BPT guidelines for the conventional pollutants covered under BPT for both subcategories. In developing BCT limits, EPA considered whether there are technologies that achieve greater removals of conventional pollutants than proposed for BPT, and whether those technologies are cost-reasonable according to the BCT Cost Test. In each subcategory, EPA identified no technologies that can achieve greater removals of conventional pollutants than those proposed for BPT that are also cost-reasonable under the BCT Cost Test, and accordingly EPA proposes BCT effluent limitations equal to the proposed BPT effluent limitations guidelines and standards.

11.4 Best Available Technology Economically Achievable (BAT)

The factors considered in establishing a BAT level of control include: the age of process equipment and facilities, the processes employed, process changes, the engineering aspects of applying various types of control techniques to the costs of applying the control technology, non-water quality environmental impacts such as energy requirements, air pollution and solid waste generation, and such other factors as the Administrator deems appropriate (Section 304(b)(2)(B) of the Act). In general, the BAT technology level represents the best existing economically achievable performance among facilities with shared characteristics. BAT may include process changes or internal plant controls which are not common in the industry. BAT may also be transferred from a different subcategory or industrial category.

EPA is proposing BAT effluent limitations for both landfill subcategories based upon the same technologies evaluated and proposed for BPT. The proposed BAT effluent limitations would control identified toxic and nonconventional pollutants discharged from facilities. EPA did not identify any additional technologies beyond BPT that could provide additional toxic pollutant removals and that are economically achievable.

11.4.1 BAT Limits for the Subtitle D Non-Hazardous Subcategory

EPA evaluated reverse osmosis technology as a potential option for establishing BAT effluent limits more stringent than BPT for the control of toxic pollutants for the Non-Hazardous subcategory. Reverse osmosis was selected for evaluation because of its effective control of a wide variety of toxic pollutants in addition to controlling conventional and nonconventional parameters.

EPA evaluated BAT treatment options as an increment to the baseline treatment technology used to develop BPT limits. Therefore, the BAT Option III consisted of BPT Option II (biological treatment followed by multimedia filtration) followed by a single stage reverse osmosis unit. Figure 11-4 presents a flow diagram of the treatment system costed for BAT Option III.

EPA is proposing limits based on a BAT technology that is equivalent to the BPT technology. After an assessment of costs and pollutant reductions associated with reverse osmosis, EPA concluded that it should not propose limits based on more advanced treatment technology than the BPT technology. EPA concluded that a biological system followed by multimedia filtration would remove the majority of toxic pollutants, leaving the single-stage reverse osmosis to treat the very low levels of pollutants that remained. In the Agency's analysis, BPT Option II removed 470,000 pounds of toxics per year whereas BAT Option III removed 500,000 pounds of toxics per year. The small incremental removal of pounds of toxics achieved by BAT Option III was not justified by the large cost for the reverse osmosis treatment system. According to EPA's costing analysis, the BAT Option III, consisting of BPT Option II plus reverse osmosis, was estimated to cost the Landfills industry $109.7 million in capital costs (1992 dollars) and $31.5 million in annualized costs (1992 dollars). By contrast, the selected option, BPT Option II, had capital costs of $18.8 million (1992 dollars) and annualized costs of $6.9 million (post-tax, 1992 dollars). It should be noted that reverse osmosis was much more effective than the proposed BPT Option II at removing the often high quantities of dissolved metals such as iron, manganese and aluminum. However, these parameters were not included in the calculation of pound-equivalent reductions due to their use as treatment chemicals.

Table 11-12 compares the long term averages achieved by BPT Option II, consisting of equalization, biological treatment, and multimedia filtration, to the long term averages achieved by the reverse osmosis treatment system. For the long term average comparison, the effluent concentrations are from the reverse osmosis treatment system sampled by EPA and described in Section 8.2.1.5, including the flow diagram in Figure 8-30. As is demonstrated by Table 11-12, the effluent concentrations achieved by BPT Option II are reduced to very low levels and are similar to the effluent concentrations achieved by the reverse osmosis system. Tables 11-6 and 11-7 present the national estimates of the pollutant of interest reductions for the BAT options for both municipal solid waste Subtitle D landfills and non-municipal Subtitle D landfills.

11.4.2 BAT Limits for the Subtitle C Hazardous Subcategory

As stated in the BPT analysis, EPA's survey of the hazardous Landfills industry identified no in-scope respondents that were classified as direct dischargers. All of the hazardous landfills in the EPA survey were indirect or zero or alternative dischargers. Therefore, the Agency based BPT limitations for the Hazardous subcategory on treatment systems in-place at non-hazardous BPT facilities and at hazardous indirect facilities. Likewise for BAT for the Hazardous subcategory, EPA evaluated the same three technology options that were evaluated for BPT in the Hazardous subcategory. These technology options, which were all demonstrated technologies among the hazardous indirect dischargers, were chemical precipitation, biological treatment with secondary clarification, and zero or alternative discharge.

For the same reasons identified in the analysis of the zero or alternative discharge option for BPT (Section 11.2.3), EPA determined that the costs were wholly disproportionate to the benefits potentially achieved by this option. Therefore, EPA is proposing BAT effluent limitations for the Hazardous landfill subcategory based upon the same treatment technology selected for BPT: equalization prior to chemical precipitation followed by biological treatment with secondary clarification.

11.5 New Source Performance Standards (NSPS)

New Source Performance Standards under Section 306 of the Clean Water Act represent the greatest degree of effluent reduction achievable through the application of the best available demonstrated control technology for all pollutants (i.e. conventional, nonconventional, and toxic pollutants). NSPS are applicable to new industrial direct discharging facilities, for which construction has commenced after the publication of proposed regulations. Congress envisioned that new treatment systems could meet tighter controls than existing sources because of the opportunity to incorporate the most efficient processes and treatment systems into plant design. Therefore, Congress directed EPA, in establishing NSPS, to consider the best demonstrated process changes, in-plant controls, operating methods, and end-of-pipe treatment technologies that reduce pollution to the maximum extent feasible.

EPA proposes New Source Performance Standards (NSPS) that would control the same conventional, toxic, and nonconventional pollutants proposed for control by the BPT effluent limitations for both subcategories. The conventional treatment technologies used to control pollutants at existing facilities are fully applicable to new facilities. Furthermore, EPA has not identified any other technologies or combinations of technologies that are demonstrated for new sources that are different from those used to establish BPT/BCT/BAT for existing sources. Therefore, EPA proposes NSPS limitations that are identical to those proposed in both subcategories for BPT/BCT/BAT.

11.6 Pretreatment Standards for Existing Sources (PSES)

Pretreatment standards are designed to prevent the discharge of toxic pollutants that pass through, interfere with, or are otherwise incompatible with the operation of POTWs, as specified in Section 307(b) of the Clean Water Act. PSES are technology-based and analogous to BAT limitations for direct dischargers.

After a thorough analysis of indirect discharging landfills in the EPA database, EPA proposes not to establish PSES for the Non-Hazardous subcategory. However, EPA proposes to establish PSES for the Hazardous subcategory based on equalization followed by chemical precipitation and biological treatment technology.

11.6.1 PSES Limits for the Subtitle D Non-Hazardous Subcategory

EPA is not proposing to establish pretreatment standards for existing sources for the Non-Hazardous subcategory. The Agency's decision not to establish PSES for this subcategory was based on several factors. EPA evaluated the effect of landfill leachate on receiving POTWs by assessing pass-through, biological inhibition levels, and contamination of POTW biosolids.

EPA conducted the pass-through analysis on the pollutants proposed to be regulated under BAT for landfills in the Non-Hazardous subcategory. Only one regulated pollutant, ammonia, was considered to "pass-through" a POTW in the Non-Hazardous subcategory. However, upon further evaluation, the Agency concluded that it would not propose pretreatment standards for ammonia. The pass-through analysis is discussed in detail in Chapter 7.

The Agency considered a number of factors in addition to the pass-through analysis to determine the need for ammonia pretreatment standards. In part, additional analysis was required because of the unique nature of ammonia in POTWs and receiving streams. First, the pass-through analysis is based on the performance of well-operated POTWs with secondary treatment in place, which generally achieve 60 percent removal of ammonia. However, in the case of ammonia, many POTWs have installed additional treatment specifically for the control of ammonia and are typically achieving removals in excess of 95 percent, which is much higher than the 60 percent removal used in this analysis. Second, ammonia is often a water quality issue, meaning that potential adverse water quality impacts may be dependent upon such receiving stream characteristics as pH and temperature. Consequently, many POTWs discharging to susceptible water bodies have strict ammonia effluent standards, and the pretreatment standards for ammonia established by local ordinances on landfill discharges should reflect the ability of the POTW to treat ammonia.

EPA has also considered establishing pretreatment standards for ammonia, with a stipulation to allow a POTW to waive those standards if the POTW has appropriate control of ammonia and can demonstrate that ammonia does not pass through the POTW. However, based on current discharges of ammonia to POTWs and current local limits established by POTWs, EPA has concluded not to establish pretreatment standards for ammonia. The rationale is further discussed below.

To determine the need for ammonia pretreatment standards for the Landfills industry, EPA considered several factors including "typical" ammonia concentrations of raw leachate, "typical" ammonia concentrations at the headworks of a POTW, the ammonia concentrations currently being discharged to POTWs, national estimates of ammonia loads discharged to POTWs and to receiving streams, as well as the economic impacts, environmental benefits, and cost-effectiveness of establishing pretreatment standards for ammonia.

To evaluate ammonia wastewater concentrations, EPA focused primarily on the means, medians, and 90th percentile of the data collected. For raw wastewater, EPA found that the median concentration of ammonia in raw landfill leachate from non-hazardous landfills was 82 mg/l, and the average concentration was 240 mg/l. Additionally, there were several notable outliers which contained high levels of ammonia in raw leachate due to site specific characteristics of the landfill. Table 11-13 lists the summary statistics of ammonia concentrations in raw landfill wastewater, as well as current discharge concentrations for direct and indirect landfills. Table 11-13 also summarizes typical ammonia concentrations found at the headworks to a POTW, and a summary of pretreatment limits set by local ordinances imposed on landfill wastewater discharges to POTWs.

In terms of current treatment performance for landfills discharging to POTWs, 99 percent of the landfill facilities are currently discharging wastewater which contains less than 90 mg/l of ammonia. Of the indirect landfills that provided data, one facility was discharging 1018 mg/l of ammonia to a 114 million gallon per day (mgd) POTW, which currently has ammonia control (nitrification) in place. In general, POTWs with nitrification achieve over 95 percent removal of ammonia. The remainder of the landfills discharged an average concentration of 37 mg/l of ammonia to POTWs, with one half of the facilities discharging less than 32 mg/l. In comparison, typical ammonia concentrations in raw domestic sewage range from 1 mg/l to 67 mg/l. Therefore, with the exception of the outlier noted above, the average concentration of ammonia in leachate discharged to POTWs was within the range of wastewater typically accepted at a the headworks to a POTW; it should be noted that the upper ranges of leachate concentrations were higher than the upper ranges found in domestic sewage.

Additionally, EPA evaluated wastewater flows and loads of ammonia associated with landfill indirect dischargers. EPA estimated that the industry discharges 3.2 million pounds per year of ammonia to POTWs, which results in 1.3 million pounds per year being discharged to receiving streams, assuming that the POTWs have secondary treatment but do not have additional treatment for ammonia control. Also, over 65 percent of the landfills discharge less than 10 pounds per day to the POTW (3500 pounds/year), which results in discharging less than 4 pounds per day (1400 pounds/year) to receiving streams, again assuming secondary treatment only. EPA analyzed impacts of ammonia discharges from landfills on receiving streams, and potential environmental benefits achieved through establishing pretreatment standards for ammonia. EPA concluded that ammonia removals achieved by national pretreatment standards would have little impact on water quality improvements (for more information see the Environmental Assessment for the Proposed Effluent Limitations Guidelines and Standards for the Landfills Category, EPA 821-B-97-007).

EPA did evaluate a number of options for PSES. EPA's economic assessment of these options showed that they generally achieved removals at a very high cost. For the control of ammonia there are two technology options available in the Landfills industry. The first available option is biological treatment. EPA evaluated PSES Option I equivalent to BAT Option I, which was equalization followed by biological treatment. This option had a total annualized cost of $28.2 million (1992 dollars) and had an average cost-effectiveness of $1,072/ lb-equivalent (1981 dollars). This option was not considered cost-effective, thus further supporting the Agency's position not to establish PSES for the Non-Hazardous subcategory. The second technology option available for the control of ammonia is ammonia stripping with appropriate air pollution controls. However, this is not considered the best option because it is not demonstrated in the industry, the costs are significantly higher than biological treatment evaluated as PSES Option I, and there are no additional pollutant removals achieved by this option. Table 11-14 and Table 11-15 show the pollutant of interest removals for PSES Option I for the municipal solid waste Subtitle D landfills and non-municipal Subtitle D landfills, respectively.

In summary, EPA concludes that landfills typically discharge wastewater to POTWs containing ammonia concentrations comparable to that of raw domestic sewage, that there are minimal benefits to be achieved through establishing national pretreatment standards for ammonia, that POTWs have the ability to establish local limits where necessary, and that the costs of pretreatment were disproportionate to the benefits.

11.6.2 PSES Limits for the Subtitle C Hazardous Subcategory

EPA proposes to establish pretreatment standards for existing sources for the Hazardous subcategory based on the same technologies as proposed for BAT for six of the thirteen toxic and nonconventional pollutants regulated under BAT for this subcategory. These standards would apply to existing facilities in the Hazardous subcategory that introduce pollutants to POTWs. The pretreatment standards would prevent the pass-through of pollutants and help control sludge contamination. According to EPA's database, all existing indirect dischargers already meet this baseline standard, and therefore, no incremental costs, benefits, or economic impacts were developed.

EPA conducted a pass-through analysis on the toxic and nonconventional pollutants proposed to be regulated under BAT for hazardous landfills. The pass-through analysis was not performed for the regulated conventional pollutants, namely BOD_5 and TSS. Conventional pollutants are amenable to treatment by a POTW and are not regulated under PSES or PSNS. Of the thirteen nonconventional and toxic pollutants regulated under BAT for the Hazardous subcategory, seven were determined to pass through. However, EPA proposes pretreatment standards for only the following six pollutants: ammonia as nitrogen, benzoic acid, toluene, alpha-terpineol, p-cresol, and aniline. Table 7-3, in Chapter 7, illustrates the results of the pass-through analysis for the Hazardous subcategory. The proposed pretreatment limitations for the Hazardous subcategory are listed in Table 11-16.

Although phenol appeared to pass through, EPA does not propose to set pretreatment standards for phenol. This decision was largely based on the rationale used in the OCPSF guideline and explained in the “Supplement to the Development Document for Effluent Limitations and Guidelines and New Source Performance Standards for the Organic Chemicals, Plastics, and Synthetic Fibers Point Source Category” (EPA 821-R-93-007). In the Supplemental Development Document, the decision not to set pretreatment standards for phenol was based on the fact that phenol is highly biodegradable and is treated by POTWs to the same degree as the OCPSF direct dischargers. Furthermore, the apparent difference in performance between OCPSF direct dischargers and POTWs was caused by the difference in influent concentrations. Both the POTW and OCPSF systems treated phenol to non-detect values (10 parts per billion (ppb)). However, the OCPSF database contained significantly higher influent concentrations than the POTWs. As a result, the performance across the OCPSF direct dischargers showed higher removals than the performance at the POTWs.

Similarly, in EPA’s landfills database, raw wastewater concentrations of phenol at the two BAT facilities (16041 and 16087) in the Hazardous subcategory were much higher than the influent concentrations at the POTWs used in the determination of the POTW percent removal. The average influent concentrations for phenol for the two hazardous BAT facilities ranged from 1,553 ppb to 65,417 ppb, and the average effluent concentrations were 10 ppb and 30 ppb corresponding to an average percent removal of 99.5 percent. For POTW performance, a total of eight POTWs that passed the POTW editing criteria developed for the landfills regulation were used in the analysis for POTW percent removal of phenol. The average influent concentration for phenol at these eight POTWs was 387 ppb, and six of the eight effluent values were below the analytical minimum level and therefore assigned values of 10 ppb. Thus, the average percent removal for the POTWs was 95.25 percent, and the pollutant was determined to pass through. In this case, as was the case in the OCPSF Supplemental Development Document, the pass-through determination may be an artifact of the differing influent concentrations and does not necessarily reflect a real difference in removals.

Therefore, EPA concluded that phenol is treated to essentially the same level by direct dischargers and POTWs and, therefore, does not pass through.

11.7 Pretreatment Standards for New Sources (PSNS)

Section 307 of the Clean Water Act requires EPA to promulgate both pretreatment standards for new sources and new source performance standards. New indirect discharging facilities, like new direct discharging facilities, have the opportunity to incorporate the best available demonstrated technologies including: process changes, in-facility controls, and end-of-pipe treatment technologies.

EPA proposes to establish pretreatment standards for new sources equivalent to the PSES standards for both subcategories. In developing PSNS limits, EPA considered whether there are technologies that achieve greater removals than proposed for PSES, and whether those technologies are cost-effective. In the Hazardous subcategory, EPA identified no technology that can achieve greater removals than PSES; therefore, EPA has set PSNS limitations based on the same technology as PSES: equalization and chemical precipitation followed by biological treatment with clarification. In the Non-Hazardous subcategory, EPA is not establishing PSNS limitations for the same rationale as for not establishing PSES limits.

Table 11-1: Removal of Pollutant of Interest Metals in the Non-Hazardous Subcategory (ug/l)

		Landfills Raw Wastewater Data		NRMRL Treatability Data (1)			50-POTW Study (3)			OCPSF 12 Plant Sampling Data (4)	
				Activated Sludge						Biological Treatment Systems	
Non-Hazardous Pollutant of Interest Metals	CAS #	Subtitle D Municipal Median Concentration	Subtitle D Non-Municipal Median Concentration	Median Influent Concentration	Percent Removal	Published Inhibition Levels (2)	Maximun Influent Concentration	Mean Influent Concentration	Median Percent Removal	Median Influent Concentration	Percent Removal
Barium	7440393	483	822	145	70.0	NV	NV	NV	NV	NV	NV
Chromium	7440473	28	NA	44	45.0	1,000-100,000	2,380	173	82	440	68.5
Strontium	7440246	1,671	4,615	1,724	13.0	NV	NV	NV	NV	NV	NV
Titanium	7440326	63.8	11.8	55	34.0	NV	NV	NV	NV	NV	NV
Zinc	7440666	140	93	372	56.0	80-5,000	9,250	723	79	322	58.5

NA - Not applicable.
NV - Not available.
(1) Source: EPA National Risk Management Research Laboratory (NRMRL) Treatability Database.
(2) Source: EPA Guidance Manual on the Development and Implementation of Local Discharge Limitations Under the Pretreatment Program.
(3) Source: EPA Fate of Priority Pollutants in Publicaly Owned Treatment Works.
(4) Source: EPA Organic Chemicals, Plastics and Synthetic Fibers Database.

Table 11-2: List of Subtitle D Municipal Solid Waste Facilities Employing Biological Treatment Considered for BPT in the Non-Hazardous Subcategory

16001	16056	16065	16085	16102	16121	16129	16159	16170
16047	16058	16077	16088	16117	16122	16132	16161	16171
16048	16059	16078	16093	16118	16123	16154	16164	16174
16049	16060	16079	16097	16119	16125	16155	16165	16176
16052	16063	16083	16099	16120	16127	16158	16166	16253

Table 11-3: Comparison of Raw Wastewater Mean Concentrations of Non-Hazardous Pollutants of Interest for Municipal Solid Waste Landfills and Hazardous Facility 16041

Cas No.	Pollutant	Mean concentration of Pollutants of Interest for All Municipal Landfills in EPA Database	Mean Concentration of Pollutants of Interest for Hazardous Facility 16041
C-002	Biochemical Oxygen Demand	1,149,485	877,875
C-004	Chemical Oxygen Demand	2,036,330	2,033,750
C-005	Nitrate/Nitrite	5,844	1,770
C-009	Total Suspended Solids	764,360	191,375
C-010	Total Dissolved Solids	4,195,518	12,275,000
C-012	Total Organic Carbon	661,481	562,250
C-020	Total Phenols	153,024	3,195
106445	P-Cresol	246	218
108101	4-Methyl 2-Pentanone	3,789	2,175
108883	Toluene	156	1,468
108952	Phenol	287	1,553
120365	Dichloroprop	10	2
123911	1,4-Dioxane	118	10
142621	Hexanoic Acid	13,148	1,632
18540299	Chromium (Hexavalent)	621	Not analyzed
20324338	Tripropyleneglycol Methyl Ether	568	1,750
298044	Disulfoton	9	Not analyzed
3268879	OCDD	0	6
35822469	1234678-HpCDD	0	1
65850	Benzoic Acid	8,423	5,294
67641	2-Propanone	2,407	4,398
68122	N,N-Dimethylformamide	214	Not analyzed
7440213	Silicon	30,913	5,518
7440246	Strontium	1,569	2,846
7440326	Titanium	66	65
7440393	Barium	720	No analyzed
7440428	Boron	3,500	8,839
7440473	Chromium	47	87
7440666	Zinc	1,530	253
75092	Methylene Chloride	309	49
7664417	Ammonia Nitrogen	238,165	382,250
78933	2-Butanone	5,874	6,398
95487	O-Cresol	298	10
98555	Alpha-Terpineol	334	691

Table 11-4: Candidate BPT Facilities for the Non-Hazardous Subcategory Without BOD_5 Effluent Data

16001	16056	16063	16083	16119	16154	16159
16047	16059	16078	16085	16121	16155	16166
16049	16060	16079	16102	16123	16158	16174

Table 11-5: Landfill Facilities Considered for BPT in the Non-Hazardous Subcategory which Supplied BOD5 Effluent Data

Facility QID	Baseline Flow (mgd)	BOD5 (ug/l) Influent	BOD5 (ug/l) Effluent	TSS (ug/l) Influent	TSS (ug/l) Effluent	Treatment in Place
16041	0.058917	910469	47000	329831	35730	Sequencing batch reactor (SBR)
16048	5.0E-06	NV	73000	NV	NV	Aerobic (oxidation pond)
16052	0.0546	NV	37000	NV	20000	Aerobic-anaerobic (lagoon)
16058	0.003	153000	24100	NV	188150	Aerated lagoon
16065	0.008	NV	35000	NV	100000	Aerobic pond
16077	0.00816	53750	10100	48500	19100	Aerated lagoon
16088	0.03621	3799333	209119	2542500	182304	Equalization, sand filter, carbon adsorption, aerobic
16093	0.081575	23524	8299	NV	NV	Activated sludge, secondary clarifier, disinfection, multimedia filtration
16097	0.019	23292	14306	35592	14104	Activated sludge, secondary clarifier
16099	0.01533	NV	11540	NV	37129	Equalization, chemical precipitation, flocculation, coalescing, anaerobic, activated sludge with PACT, nitrification, secondary clarifier
16117	0.04	179571	4786	47600	6875	Equalization, chemical precipitation, primary clarifier, aerated fixed film, secondary clarifier, denitrification
16118	0.0288	1990351	48100	NV	NV	Equalization, chemical precipitation, primary clarifier, anaerobic, aerobic, secondary clarifier
16120	0.042775	789804	4330	1221000	13748	Settling, aeration, chemical precip, primary clarifier, air stripper, neutralization, activated sludge, secondary clarifier, multimedia filtration, disinfection
16122	0.0255	1007111	41100	266733	5440	Equalization, chemical precipitation, primary clarifier, anaerobic, aerobic, secondary clarifier, aerobic equalization, multimedia filtration
16125	0.014193	1672500	56900	210765	12717	Aeration, chemical precipitation, primary clarifier, SBR, secondary clarifier, carbon adsorption, multimedia filtration
16127	0.003627	NV	39808	NV	17981	Unstirred tank, aeration
16129	0.00469	213655	1835	43848	2651	Neutralization (lime), chemical precipitation, primary clarifier, activated sludge, secondary clarifier, sand filter, air stripping
16132	0.03	7609318	15700	244333	47000	Aerated pond
16161	0.053	NV	171000	NV	68000	Aeration, aerobic, settling (aerated pond)
16164	0.01	NV	487000	NV	46000	Aeration, chemical precipitation, primary clarifier, neutralization, equalization, aerobic, secondary clarifier
16165	0.030218	1812000	974000	94000	115000	Aerobic, settling (aerated pond)
16170	0.0048	68636	63000	44125	20500	Equalization, stabilization pond
16171	0.024	327200	213000	150000	122000	Equalization, activated sludge, settling
16176	0.037272	NV	112000	NV	88000	Aeration, activated sludge, settling
16253	0.01776	327000	6420	150000	26400	Equalization, chemical precipitation, primary clarifier, anaerobic, activated sludge, secondary clarifier, nitrification, multimedia filtration

NV: Not Available

Table 11-6: National Estimates of Pollutant of Interest Reductions for BPT/BAT Options for Municipal Solid Waste Landfills - Direct Dischargers

		National Estimates			
Pollutant of Interest CAS Number	Pollutant of Interest	Current Discharge Loads (pounds/yr)	BPT/BAT Option I Loads (pounds/yr)	BPT/BAT Option II Loads (pounds/yr)	BAT Option III- RO Loads (pounds/yr)
C-020	Total Phenols	825	167	111	NA
C-012	Total Organic Carbon	808,588	308,537	147,311	NA
C-010	Total Dissolved Solids	14,052,754	13,932,764	13,116,881	NA
C-009	Total Suspended Solids	357,144	130,724	72,603	NA
C-005	Nitrate/Nitrite	109,647	108,992	109,647	NA
C-004	Chemical Oxygen Demand	2,523,010	1,301,591	1,291,556	NA
C-002	Biochemical Oxygen Demand	452,923	100,689	100,689	NA
7664417	Ammonia Nitrogen	204,481	29,159	3,199	55
18540299	Chromium (Hexavalent)	179	56	89	52
7440393	Barium	1,368	1,136	663	655
7440473	Chromium	116	95	97	50
7440246	Strontium	3,578	547	912	547
7440326	Titanium	130	20	60	20
7440666	Zinc	936	197	193	98
123911	1,4-Dioxane	56	56	55	55
78933	2-Butanone	3,023	107	105	54
67641	2-Propanone	1,741	142	118	54
108101	4-Methyl-2-Pentanone	238	98	53	53
98555	Alpha-terpineol	259	55	55	55
65850	Benzoic Acid	6,698	272	191	54
142621	Hexanoic Acid	9,762	55	55	55
75092	Methylene Chloride	389	40	40	40
68122	N,N-Dimethylformamide	71	55	55	55
95487	O-Cresol	64	54	54	54
106445	P-Cresol	159	49	49	49
108952	Phenol	310	57	55	55
108883	Toluene	202	36	36	36
20324338	Tripropyleneglycol Methyl Ether	864	55	55	55
120365	Dichlorprop	17	17	17	17
298044	Disulfoton	23	11	11	11
35822469	1,2,3,4,6,7,8-HPCDD	0.00	0.00	0.00	0.00
3268879	OCDD	0.01	0.00	0.00	0.00

Table 11- 7: National Estimates of Pollutant of Interest Reductions for BPT/BAT Options for Non-Municipal Solid Waste Landfills - Direct Dischargers

		National Estimates		
Pollutant of Interest CAS Number	Pollutant of Interest	Current Discharge Loads (pounds/yr)	BPT/BAT Option I Loads (pounds/yr)	BPT /BAT Option II Loads (pounds/yr)
C-002	BOD	144,314	51,898	51,898
C-004	COD	2,340,246	726,056	718,197
C-009	TSS	55,085	50,479	24,168
C-005	Nitrate/Nitrite	2,463	2,463	2,463
C-020	Total Phenols	518	105	54
C-012	TOC	500,644	173,798	68,636
C-010	TDS	10,221,640	10,221,640	6,914,849
7664417	Ammonia as Nitrogen	167,097	14,219	1,428
7440246	Strontium	9,554	242	403
94746	MCPA	904	280	280

Table 11-8: Annual Pollutant Discharge Before and After the Implementation of BPT for Subtitle D Municipal Solid Waste Landfill Facilities in the Non-Hazardous Subcategory

Pollutant Group	Current Annual Pollutant Discharge (pounds)	Annual Pollutant Discharge After Implementation of BPT (pounds)	Annual Amount of Pollutants Removed by BPT (pounds)
Conventional Pollutants	810,000	132,600	677,400
Nonconventional Pollutants	17,700,000	14,670,000	3,030,000
Metal Pollutants	6,300	2,000	4,300
Organic Pollutants	23,800	900	22,900
Pesticides	40	28	12
Dioxins/ Furans	0.0	0.0	0.0

Table 11-9: Annual Pollutant Discharge Before and After The Implementation of BPT for Subtitle D Non-Municipal Landfill Facilities in the Non-Hazardous Subcategory

Pollutant Group	Current Annual Pollutant Discharge (pounds)	Annual Pollutant Discharge After Implementation of BPT (pounds)	Annual Amount of Pollutants Removed by BPT (pounds)
Conventional Pollutants	204,000	46,000	158,000
Nonconventional Pollutants	13,500,000	7,900,000	5,600,000
Metal Pollutants	11,900	1,100	10,800
Organic Pollutants	208	74	134
Pesticides	1,500	730	770
Dioxins/ Furans	0.0	0.0	0.0

Table 11-10: BPT Limitations for the Non-Hazardous Subcategory

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
BOD_5	160	40
TSS	89	27
Ammonia	5.9	2.5
Alpha Terpineol	0.059	0.029
Benzoic Acid	0.23	0.13
P-Cresol	0.046	0.026
Phenol	0.045	0.026
Toluene	0.080	0.026
Zinc	0.20	0.11
pH	([1])	([1])

([1]) pH shall be in the range 6.0 - 9.0 pH units.

Table 11-11: BPT Limitations for the Hazardous Subcategory

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
BOD_5	160	40
TSS	89	27
Ammonia	5.9	2.5
Alpha Terpineol	0.042	0.019
Aniline	0.024	0.015
Benzene	0.14	0.036
Benzoic Acid	0.12	0.073
Naphthalene	0.059	0.022
P-Cresol	0.024	0.015
Phenol	0.048	0.029
Pyridine	0.072	0.025
Toluene	0.080	0.026
Arsenic	1.0	0.52
Chromium	0.86	0.40
Zinc	0.37	0.21
pH	([1])	([1])

([1]) pH shall be in the range 6.0 - 9.0 pH units.

Table 11-12: Comparison of Long Term Averages for Nonconventional and Toxic Pollutants Proposed to be Regulated Under BPT and BAT

Pollutant	BPT Option II: Equalization + Biological + Multimedia Filter	Reverse Osmosis single stage effluent	Reverse Osmosis second stage effluent
Ammonia	1.4	13	0.59
Zinc	0.68	0.010 ND	0.011
Alpha Terpineol	0.018	0.010 ND	0.010 ND
Benzoic Acid	0.091	0.079	0.010 ND
P-Cresol	0.018	0.233	0.022
Phenol	0.018	0.183	0.029
Toluene	0.010 ND	0.114	0.016

ND: Non-detect

Table 11-13: Comparison of Ammonia Concentrations in Wastewaters

	Raw Leachate (mg/l) Non-hazardous landfills [1]	Current Discharge to Stream (mg/l) Direct Discharging Landfills [1]	Current Discharge to POTW (mg/l) Indirect Discharging Landfills [1]	Existing Pretreatment Standards established by POTWs [1] (mg/l)	Typical Domestic Sewage Concentration (mg/l)
Median	82	13	82	100 [2] 50 [3]	14 [4]
Average	240	19	76	260 [2] 400 [3]	15 [4]
Range	1 - 2,900	ND - 100	1 - 1,000	7 - 1,000 [2] 5 - 1,500 [3]	1 - 67 [4]

ND: Non-detect
(1) data collected through EPA sampling and Waste Treatment Industry: Landfills Questionnaire.
(2) monthly average.
(3) daily maximum .
(4) data from “50-POTW Study”.

Table 11-14: National Estimates of Pollutant of Interest Reductions for PSES/PSNS Options for Municipal Solid Waste Landfills - Indirect Dischargers

Pollutant of Interest CAS Numbers	Pollutant of Interest	National Estimates	
		Current Discharge Loads (pounds/yr)	PSES/PSNS Option I Loads (pounds/yr)
C-004	CHEMICAL OXYGEN DEMAND	38,760,137	12,955,244
C-020	TOTAL PHENOLS	24,753	1,959
C-012	TOTAL ORGANIC CARBON	13,862,541	3,154,103
C-010	TOTAL DISSOLVED SOLIDS	113,527,543	111,388,250
C-005	NITRATE/NITRITE	48,539	48,539
7664417	AMMONIA NITROGEN	3,061,931	246,762
18540299	CHROMIUM (HEXAVALENT)	2,595	464
7440393	BARIUM	18,108	17,985
7440473	CHROMIUM	1,204	880
7440246	STRONTIUM	60,712	4,196
7440326	TITANIUM	2,286	197
7440666	ZINC	5,942	1,889
123911	1,4-DIOXANE	449	449
78933	2-BUTANONE	62,943	1,165
67641	2-PROPANONE	35,771	1,534
108101	4-METHYL-2-PENTANONE	3,628	1,048
98555	ALPHA-TERPINEOL	4,464	420
65850	BENZOIC ACID	138,815	2,098
142621	HEXANOIC ACID	206,848	420
75092	METHYLENE CHLORIDE	3,741	402
68122	N,N-DIMETHYLFORMAMIDE	446	420
95487	O-CRESOL	597	419
106445	P-CRESOL	2,720	410
108952	PHENOL	4,343	440
108883	TOLUENE	6,237	406
20324338	TRIPROPYLENEGLYCOL METHYL ETHER	7,906	420
298044	DISULFOTON	238	84
120365	DICHLORPROP	228	228
35822469	1,2,3,4,6,7,8-HPCDD	0	0
3268879	OCDD	0	0

Table 11-15: National Estimates of Pollutant of Interest Reductions for PSES/PSNS Option I for Non-municipal Solid Waste Landfills - Indirect Dischargers

		National Estimates	
Pollutant of Interest CAS Number	Pollutant of Interest	Current Discharge Loads (pounds/year)	PSES/PSNS Option I Loads (pounds/year)
C-004	COD	1,937,002	611,146
C-020	Total Phenols	407	88
C-012	TOC	413,238	144,913
C-010	TDS	8,135,113	8,135,113
C-005	Nitrate/Nitrite	2,250	2,250
7664417	Ammonia as Nitrogen	140,371	11,903
7440246	Strontium	7,443	202
94746	MCPA	714	230

Table 11-16: PSES and PSNS Limitations for the Hazardous Subcategory

Pollutant or Pollutant Property	Maximum for 1 day (mg/l)	Monthly Average Shall Not Exceed (mg/l)
Ammonia	5.9	2.5
Alpha Terpineol	0.042	0.019
Aniline	0.024	0.015
Benzoic Acid	0.12	0.073
P-Cresol	0.024	0.015
Toluene	0.080	0.026
pH	([1])	([1])

([1]) pH shall be in the range 6.0 - 9.0 pH units.

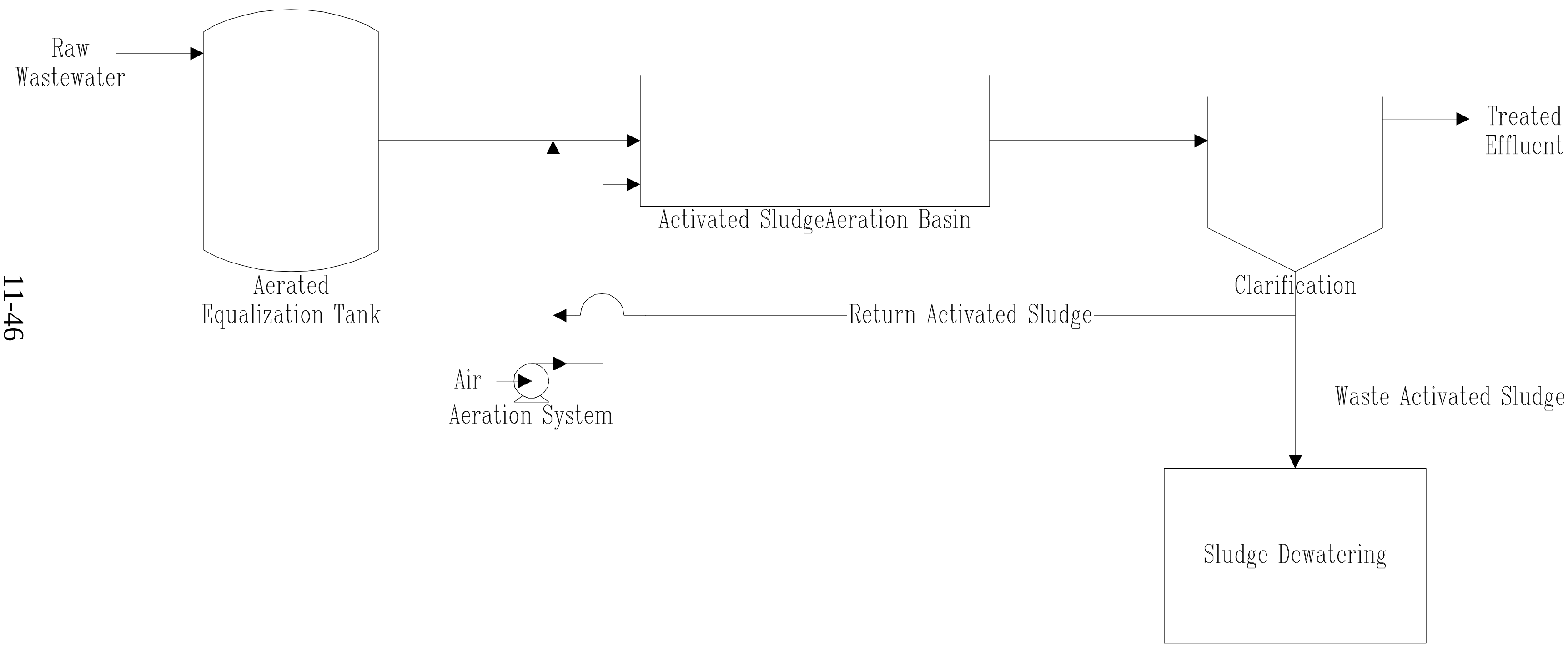

Figure 11-1. BPT/BCT/BAT/PSES/PSNS Non-Hazardous Subcategory Option I Flow Diagram

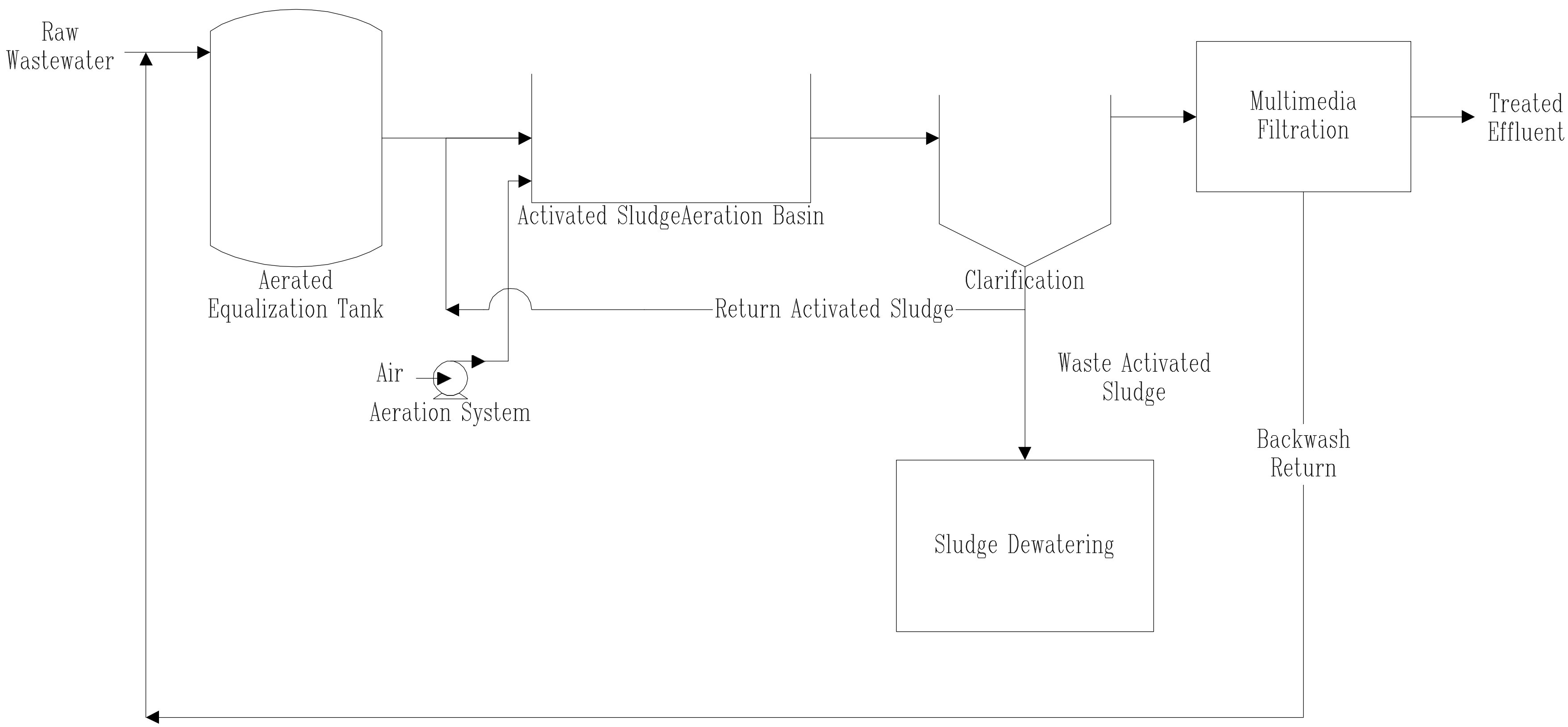

Figure 11-2. BPT/BCT/BAT Non-Hazardous Subcategory Option II & NSPS Flow Diagram

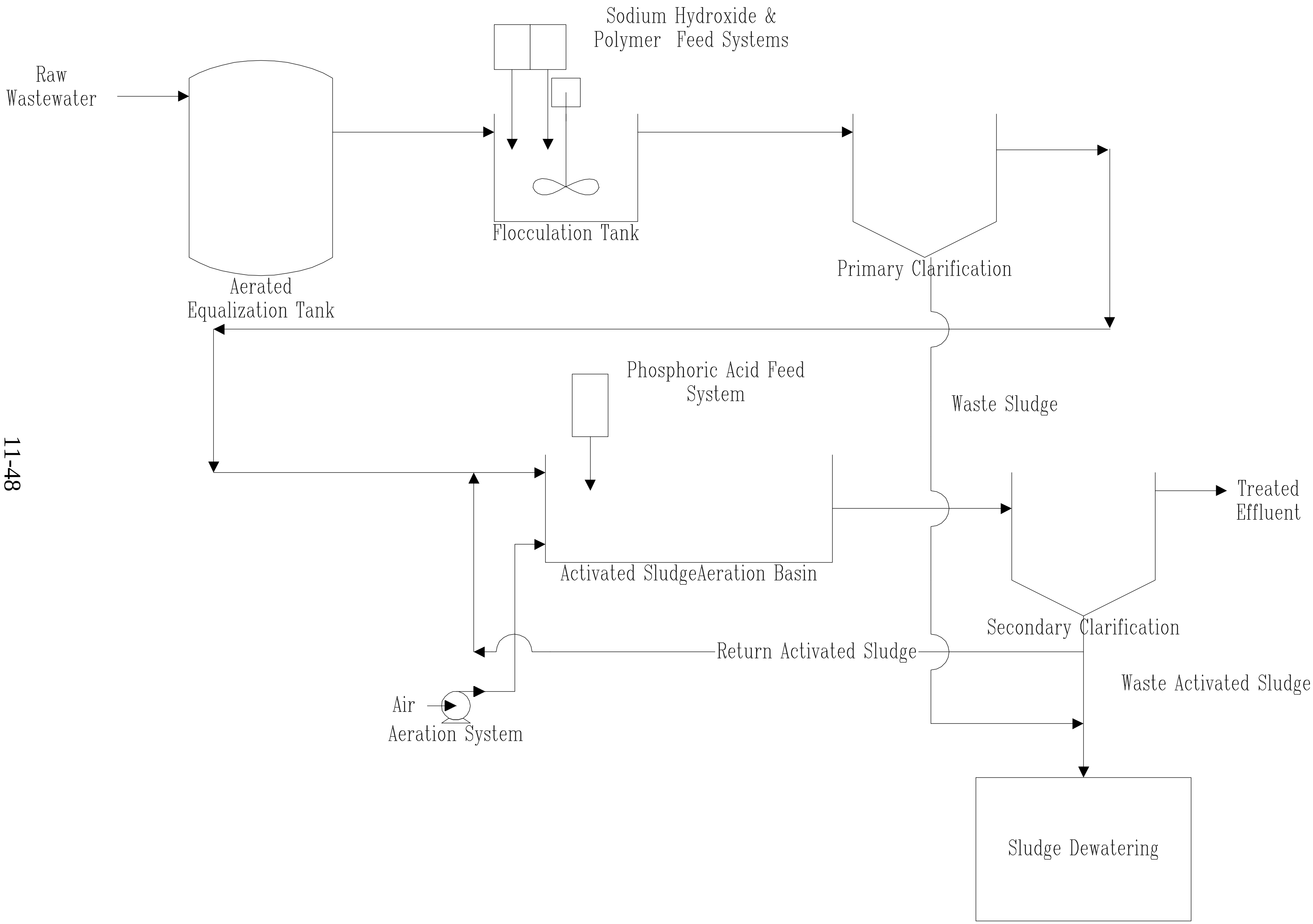

Figure 11-3. BPT/BCT/BAT/PSES Hazardous Subcategory Option I & NSPS/PSNS Flow Diagram

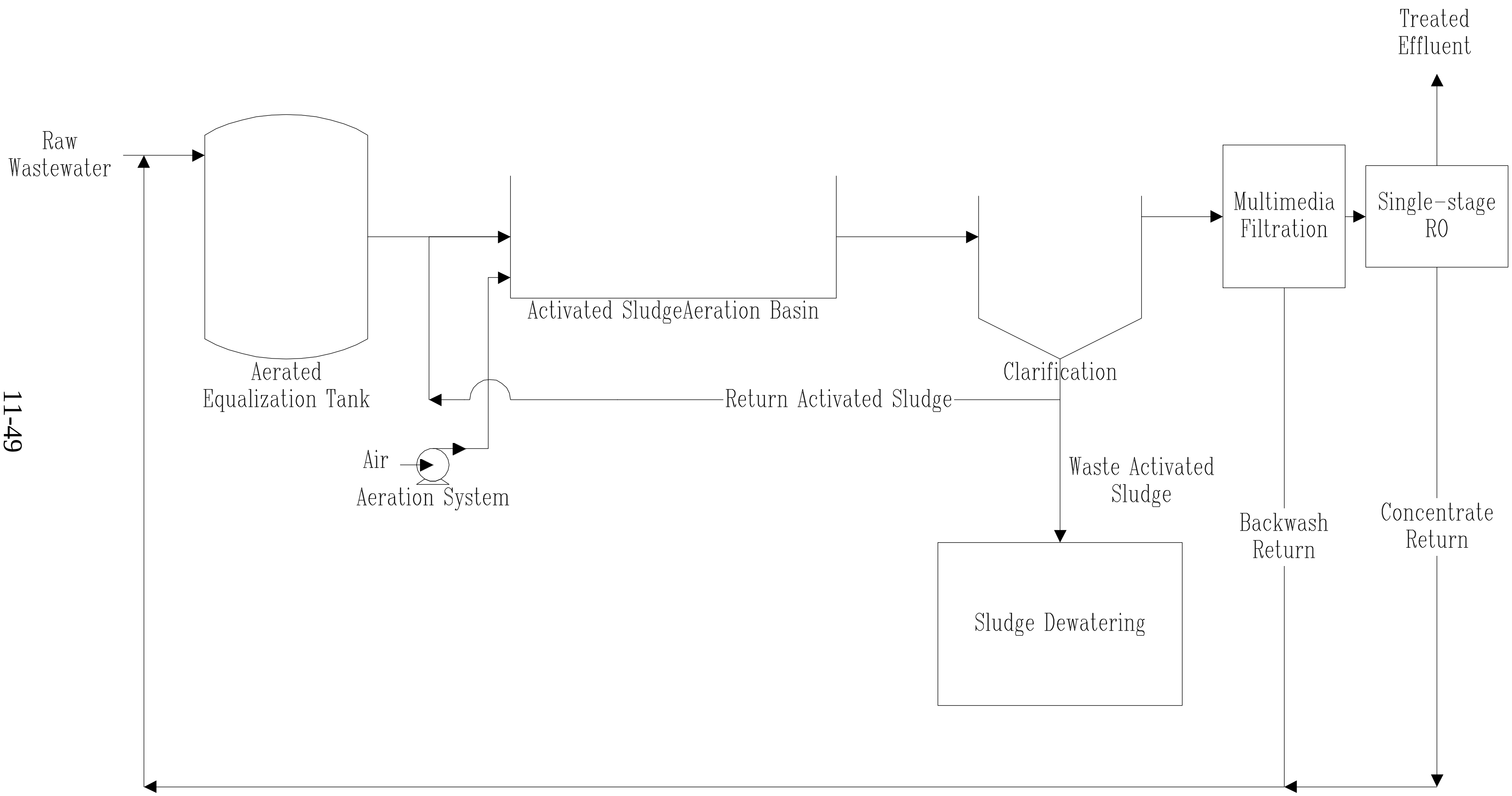

Figure 11-4. BAT Hazardous Subcategory Option III Flow Diagram

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APPENDIX A:

SECTION 308 SURVEY FOR LANDFILLS - INDUSTRY POPULATION ANALYSIS

Appendix A: Section 308 Survey for Landfills-Industry Population Analysis

The list of landfills needed to define the landfill population in the United States was developed from various sources: state environmental and solid waste departments, and other state contacts; the National Survey of Hazardous Waste Treatment Storage, Disposal, and Recycling Facilities respondent list; Environmental Ltd.'s 1991 Directory of Industrial and Hazardous Waste Management Firms; the Resource Conservation and Recovery Act (RCRA) 1992 list of Municipal Solid Waste Landfills; and the Resource Conservation and Recovery Information System (RCRIS) National Oversight Database.

The information provided by state environmental departments was requested during early stages of the rulemaking process for Centralized Waste Treatment and represented 1987-88 data for both active and inactive landfills. This information was incomplete to some extent. For 18 of the 50 states only limited or no information was available. Hence, these states were contacted during the data gathering effort for the development of effluent guidelines and standards for Landfills and Incinerators to obtain updated lists of landfills and wastewater collection information.

The duplication of landfill entries among various sources was eliminated as far as possible by cross checking using computer programs. However, some duplication in Subtitle D landfills is inevitable as some of the various identifiers were unclear.

Landfill population was divided into two categories: Subtitle C (hazardous waste) and Subtitle D (non-hazardous waste). In total, mailing addresses were compiled for 595 Subtitle C landfills and 9,882 Subtitle D landfills. In addition, 448 Subtitle D landfills were identified for which addresses were inadequate for delivery. Thus the population of Subtitle D amounted to 10,330. Table 1 provides a list of the number of landfills with deliverable mailing addresses in each state by category.

Selection of the landfills to survey

From the identified landfill population of 10,925 Subtitle C and D facilities, screener surveys were mailed to 4996. Facilities receiving the screener survey included all of the 595 Subtitle C landfills and a sample of the 9,882 Subtitle D facilities with mailable addresses.

TABLE 1. COUNT OF LANDFILLS WITH MAILABLE ENTRIES IN EACH STATE

State	Subtitle-D	Subtitle-C	Total
Alabama	238	38	276
Alaska	201	1	202
Arizona	90	2	92
Arkansas	134	3	137
California	630	16	646
Colorado	216	12	228
Connecticut	125	22	147
Delaware	8	14	22
Florida	91	9	100
Georgia	277	17	294
Hawaii	15	1	16
Idaho	112	6	118
Illinois	182	14	196
Indiana	101	29	130
Iowa	118	13	131
Kansas	118	8	126
Kentucky	121	33	154
Louisiana	73	17	90

State	Subtitle-D	Subtitle-C	Total
Maine	291	2	293
Maryland	50	5	55
Massachu-setts	722	1	723
Michigan	762	9	771
Minnesota	257	4	261
Mississippi	97	3	100
Missouri	128	7	135
Montana	257	1	258
Nebraska	41	8	49
Nevada	127	3	130
New Hapmshire	58	0	58
New Jersey	467	8	475
New Mexico	121	7	128
New York	565	10	575
North Carolina	244	39	283
North Dakota	85	1	86
Ohio	119	24	143
Oklahoma	189	7	196
Oregon	231	10	241
Pennsyl-vania	41	22	63
Rhode Island	12	0	12
South Carolina	127	9	136

State	Subtitle-D	Subtitle-C	Total
South Dakota	193	0	193
Tennessee	112	9	121
Texas	601	70	671
Utah	92	7	99
Vermont	73	0	73
Virginia	440	8	448
Washing-ton	72	9	81
West Virginia	57	5	62
Wisconsin	183	3	186
Wyoming	218	45	263
Puerto Rico	0	3	3
Guam	0	1	1
Total	9882	595	10477

The remaining 4401 screener surveys were sent to Subtitle D landfills. A statistical approach was taken to sample the 9882 deliverable Subtitle D facilities. For sampling purposes, the 9882 Subtitle D landfills were stratified into three categories:

1) landfills with known wastewater collection
2) landfills from states with fewer than 100 landfills and
3) landfills from states with more than 100 landfills.

All landfills with known wastewater collection were included in the landfill survey sample. The population included 134 landfills with known wastewater collection (1.35%).

Landfills in states with fewer than 100 landfills were stratified from the landfills in states with more than 100 landfills. This was simply a sampling technique for random sampling and was done to ensure the inclusion of a representative number of facilities from each stratum.

There were 16 states with under 100 landfills each (after exclusion of known wastewater collectors), which accounted for 892 landfills. A screener survey was mailed to each of these 892 landfills. The remaining 24 states, with over 100 landfills each, accounted for 8856 landfills. A random sample of 3375 was taken from this strata, and a screener survey was mailed to each of these randomly selected landfills. Table 2 summarizes the stratification.

Screener surveys were distributed by both Federal Express and U.S. certified mail: 1916 surveys were sent via Federal Express, which resulted in 94% receipt confirmation; 3080 surveys were sent via U.S. certified mail, which resulted in 92% receipt confirmation. Twenty three additional screener surveys were mailed because of change of ownership, or different mailing address, even though the physical location of the landfill remained same. A summary of analysis on these additional surveys is presented in Table 3. Thus, a total of 5020 landfill screener surveys were distributed.

TABLE 2. SUMMARY OF STRATIFICATION

Strata #	Population	# in frame	# in sample
1	Subtitle C	595	595
2	Subtitle D -known wastewater generators	134	134
3	Subtitle D - states with ≤ 100 landfills	892	892
4	Subtitle D - states with >100 landfills	8856	3375
	Total	10477	4996

A completed screener survey was received from 3628 landfills excluding the late arrivals. This includes response from a pre-test screener survey. The status of remaining screener surveys is:

- 353 surveys were deemed non-deliverables due to incorrect/non-traceable addresses and were returned to the sender
- 1008 landfills were presumed to be non-respondents
- 4 landfills were found to be out-of-business
- 26 landfills were declared ineligible to participate in the survey for reasons discovered during the mid-point remainder calls
- 1 respondent refused to respond to the survey.

For statistical analysis purposes, screener surveys in each of the above categories were traced back to the respective strata. Table 4 presents a breakdown of these remaining screener surveys by strata.

TABLE 3. SUMMARY OF ADDITIONAL SCREENER SURVEY ANALYSIS

Screener ID	Original ID	Stratum	Reason for re-assignment
15100	13235	4	screener sent to former owner or incorrect address
15101	14044	4	screener sent to former owner or incorrect address
15102	13876	4	screener sent to former owner or incorrect address
15103	11594	4	screener sent to former owner or incorrect address
15104	14117	4	screener sent to former owner or incorrect address
15105	13953	4	screener sent to former owner or incorrect address
15106	13264	4	screener sent to former owner or incorrect address
15107	10985	4	additional screener resp. was obtained for a new landfill
15108	14449	4	additional screener resp. was obtained for a new landfill
15109	12167	1	additional screener resp. was obtained for a new landfill
15110	12883	4	additional screener resp. was obtained for a new landfill
15111			response transferred from pre-test screener survey
15112	14112	4	screener sent to former owner or incorrect address
15113	11319	3	screener sent to former owner or incorrect address
15114	12327	4	screener sent to former owner or incorrect address
15116	11528	4	screener sent to former owner or incorrect address
15117	13389	3	screener sent to former owner or incorrect address
15118	13995	4	screener sent to former owner or incorrect address
15119	14779	4	screener sent to former owner or incorrect address
15120	11422	4	screener sent to former owner or incorrect address
15121	13976	4	screener sent to former owner or incorrect address
15122	12422	1	screener sent to former owner or incorrect address
15123	11299	4	screener sent to former owner or incorrect address
15124	10851	4	screener sent to former owner or incorrect address

Among the 3628 survey responses received, a total of 3581 surveys were sent to data entry; 44 were declared ineligible upon reviewing their response, and were not processed any further; 3 remained incomplete because of unsuccessful attempts to contact the respondents to complete the review process. A total of 859 respondents were found collecting some type of wastewater (landfills collecting only storm water were not included) generated from their landfill operations, and were considered as in scope population from which a sample of facilities will be selected to receive the detailed Section 308 landfill questionnaire. The rest of the surveys sent to data entry were considered out of scope. For statistical analysis purposes, screener surveys not sent to data entry, the out of scope surveys, and the in scope surveys were traced back to the respective strata, and a count of these in each strata is presented in Table 4.

A response bias query was conducted on about 5.65% (57 landfills) of the 1008 presumed non-respondents. Each of these 57 randomly-selected landfills was called to discern the reasons that the screener survey was not received. The result of this effort is as follows:

- 25 facility contacts said that they over looked/misplaced/forgotten the survey (1 in stratum 2; 1 in stratum 3; and 23 in stratum 4)

- 19 facility contacts said that they did not recall receiving any survey (2 in stratum 1; 3 in stratum 3; and 14 in stratum 4)

- 7 facility contacts said that they did not feel it was applicable to them (1 in stratum 1; 2 in stratum 3; and 4 in stratum 4)

- 3 facility contacts said that they forgot and would complete the survey and return (2 in stratum 3; and 1 in stratum 4)

- 2 facility contacts said that they received duplicate surveys, and this was checked and found correct (these 2 are in stratum 4)

- 1 facility contact said that they are under bankruptcy proceedings (this is in stratum 1).

A total of 39 landfill screener survey responses were received past the deadline. since these were received after the close of the screener survey database, they were not considered for any further analyses. Among these 39 late arrivals, only four landfills collected wastewater generated from landfill operations (landfill leachate and contaminated groundwater), and none of these four landfills have any on-site treatment. Additional information on these four landfills is: two were municipal, non-commercial, and discharged untreated wastewater to a Publicly Owned Treatment Works (POTW); one was government, commercial, and discharged untreated wastewater to a POTW; one was private and sent their wastewaters for off-site disposal.

Questionnaire distribution

A total of 859 landfill operators reported that they collect one or more type of wastewater generated from the landfill operations (landfills collecting only storm water were not included). These landfills were considered as the sample frame to receive the Section 308 questionnaire for landfills. Facilities with treatment were targeted most heavily, while some facilities without treatment but collect wastewater were randomly selected to receive only Section A of the questionnaire. The facilities selected fall into any of the following eight categories:

1. Commercial private, municipal, or government facilities which have wastewater treatment and are direct or indirect dischargers. A census was conducted of this part of the industry.

2. Commercial private, municipal, or government facilities which have wastewater treatment and are zero dischargers (do not discharge to surface water or to a POTW). Approximately 25% of these were randomly chosen to receive the questionnaire.

3. Non-commercial private facilities with wastewater treatment. Approximately 40% of these were randomly chosen to receive the questionnaire.

4. Facilities with no wastewater treatment. Approximately 10% of these were randomly chosen to receive only Section A of the questionnaire.

5. Commercial facilities who accept PCB wastes. Only one facility was in this category, and was chosen.

6. Municipal hazardous waste landfills. There were two facilities in this category, and a census was conducted of this part of the industry.

7. Small business with no wastewater treatment. A census was conducted of this part of the industry.

8. Pre-test facility which was not in the screener population. Only one facility was in this category, and was chosen based on knowledge of the industry and professional judgement.

For statistical analysis purposes, the facilities in each of the aforementioned categories were traced back through their screener surveys to the respective strata, and a count of these in each strata is presented in Table 5.

Section 308 Questionnaires were sent to a total of 252 mailing addresses that were considered in scope from their screener responses. The questionnaire response was received from 248 landfills. The remaining four landfills were presumed to be non-respondents. The questionnaire responses received included four responses from pre-test questionnaires. Thus a total of 248 responses were available for further review.

Among the survey responses obtained, 22 were declared out of scope upon reviewing their response and were not processed any further; 226 were reviewed for completeness and technical accuracy and were entered into the landfill questionnaire database. For statistical analysis purposes, the 252 questionnaires that were sent, including the 226 questionnaires reviewed and placed in the database, were traced back to the original screener population strata, and a count of these in each strata is presented in Table 4.

TABLE 4. COUNT OF SCREENER SURVEYS IN EACH CATEGORY BY STRATA[1]

Category	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Total
Non-respondents	69	15	170	755	1009
Ineligible[2]	79	9	45	294	427
Incomplete	2	0	1	0	3
In scope	141	91	222	405	859
Out of scope	305	20	456	1941	2722
Quest. recipients	51	35	77	88	252[3]
Quest. in database	46	32	71	76	226[3]
Quest. out of scope	4	3	4	11	22
Quest. non-response	1	0	2	1	4

[1]For each of the category presented below, a list of Survey ID numbers and their respective strata # is presented in Appendix A.

[2]This includes all non-deliverables, out-of-business, and duplicate addresses.

[3]An additional one is the pre-test questionnaire, which is not part of any stratum.

TABLE 5. QUESTIONNAIRE SELECTION BY CATEGORY

Category	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Total
Pri/com/muni/govt./with treat/D-I discharge	12	27	51	38	128
Pri/non-com/with treatment	30	2	3	7	42
Pri/com/muni/govt./with treat/Zero discharge	1	0	7	0	8
No treatment	5	6	14	38	63
PCB facilities with treatment	0	0	1	0	1
Municipal/hazardous	2	0	0	0	2
Small business/no treatment	1	0	1	5	7
Pre-test not in Screener population[4]	-	-	-	-	1
Totals	51	35	77	88	252

[4]This is a pre-test questionnaire and is not in any stratum because, it was not in the screener database.

TABLE 6. IN SCOPE SCREENERS NOT SELECTED FOR QUESTIONNAIRE BY CATEGORY

Category	Stratum 1	Stratum 2	Stratum 3	Stratum 4	Total
Pri/com/muni/govt./with treat/D-I discharge	0	0	0	0	0
Pri/non-com/with treatment	31	0	6	27	64
Pri/com/muni/govt./with treat/Zero discharge	7	2	9	7	25
No treatment	52	54	130	283	519
PCB facilities with treatment	0	0	0	0	0
Municipal/hazardous	0	0	0	0	0
Small business/no treatment	0	0	0	0	0
Totals	90	56	145	317	608

APPENDIX B:

DEFINITIONS, ACRONYMS, AND ABBREVIATIONS

Appendix B: Definitions, Acronyms, and Abbreviations

ADMINISTRATOR: The Administrator of the U.S. Environmental Protection Agency.

AGENCY: The U.S. Environmental Protection Agency.

AVERAGE MASTER FILE: A method of calculating the average raw wastewater concentration for each pollutant of interest in a subcategory. The Average Master File was calculated using all available data collected in the Landfills industry study.

BASELINE FLOW: Estimated wastewater discharge flow rate for a selected facility in 1992 based on their Detailed Questionnaire response.

BAT: The best available technology economically achievable, applicable to effluent limitations to be achieved by July 1, 1984, for industrial discharges to surface waters, as defined by Sec. 304(b)(2)(B) of the CWA.

BCT: The best conventional pollutant control technology, applicable to discharges of conventional pollutants from existing industrial point sources, as defined by Sec. 304(b)(4) of the CWA.

BOD_5: Biochemical oxygen demand - Five Day. A measure of the biochemical decomposition of organic matter in a water sample. It is determined by measuring the dissolved oxygen consumed by microorganisms to oxidize the organic contaminants in a water sample under standard laboratory conditions of five days and 70 degrees Celsius. BOD_5 is not related to the oxygen requirements in chemical combustion.

BPT: The best practicable control technology currently available, applicable to effluent limitations to be achieved by July 1, 1977, for industrial discharges to surface waters, as defined by Sec. 304(b)(1) of the CWA.

CAPDET:
Computer-Assisted Procedure for the Design and Evaluation of Wastewater Treatment Systems. Developed by the U.S. Army Corp. of Engineers, CAPDET is intended to provide planning level cost estimates to analyze alternate design technologies for wastewater treatment systems.

CAPTIVE: Used to describe a facility that only accepts wastes generated on site and/or by the landfill owner/operator at the facility.

CELL:
An area of a landfill that is separated from other areas by an impervious structure. Each cell has a separate leachate collection system or would require a separate leachate collection system if one were installed. Individual leachate collection systems that are combined at the surface are considered separate systems by this definition.

CLEAN WATER ACT (CWA): The Federal Water Pollution Control Act Amendments of 1972 (33 U.S.C. Section 1251 et seq.), as amended by the Clean Water Act of 1977 (Pub. L. 95-217), and the Water Quality Act of 1987 (Pub. L. 100-4).

CLEAN WATER ACT (CWA) SECTION 308 QUESTIONNAIRE:
A questionnaire sent to facilities under the authority of Section 308 of the CWA, which requests information to be used in the development of national effluent guidelines and standards.

CLOSED: A facility or portion thereof that is currently not receiving or accepting wastes and has undergone final closure.

COMMERCIAL FACILITY: A facility that treats, disposes, or recycles/recovers the wastes of other facilities not under the same ownership as this facility. Commercial operations are usually made available for a fee or other remuneration. Commercial waste treatment, disposal, or recycling/recovery does not have to be the primary activity at a facility for an operation or unit to be considered "commercial".

CONTAMINATED GROUNDWATER: Water below the land surface in the zone of saturation which has been contaminated by landfill leachate. Contaminated groundwater occurs at landfills without liners or at facilities that have released contaminants from a liner system. Groundwater may also become contaminated if the water table rises to a point where it infiltrates the landfill or the leachate collection system.

CONTAMINATED STORM WATER: Storm water which comes in direct contact with the waste or waste handling and treatment areas. Storm water which does not come into contact with the wastes is not subject to the proposed limitations and standards.

CONVENTIONAL POLLUTANTS: Constituents of wastewater as determined by Sec. 304(a)(4) of the CWA, including pollutants classified as biochemical oxygen demand, total suspended solids, oil and grease, fecal coliform, and pH.

DEEP WELL INJECTION: Disposal of wastewater into a deep well such that a porous, permeable formation of a larger area and thickness is available at sufficient depth to ensure continued, permanent storage.

DETAILED MONITORING QUESTIONNAIRE (DMQ): Questionnaires sent to collect monitoring data from 27 selected landfill facilities based on responses to the Section 308 Questionnaire.

DIRECT DISCHARGER: A facility that discharges or may discharge treated or untreated wastewaters into waters of the United States.

DRAINED FREE LIQUIDS: Aqueous wastes drained from waste containers (e.g., drums, etc.) prior to landfilling. Landfills which accept containerized waste may generate this type of wastewater.

EFFLUENT LIMITATION: Any restriction, including schedules of compliance, established by a State or the Administrator on quantities, rates, and concentrations of chemical, physical, biological, and other constituents which are discharged from point sources into navigable waters, the waters of the contiguous zone, or the ocean. (CWA Sections 301(b) and 304(b).)

EPA: The U.S. Environmental Protection Agency.

EXISTING SOURCE: Any facility from which there is or may be a discharge of pollutants, the construction of which is commenced before the publication of the proposed regulations prescribing a standard of performance under Sec. 306 of the CWA.

FACILITY: All contiguous property owned, operated, leased or under the control of the same person or entity.

GAS CONDENSATE: A liquid which has condensed in the landfill gas collection system during the extraction of gas from within the landfill. Gases such as methane and carbon dioxide are generated due to microbial activity within the landfill, and must be removed to avoid hazardous conditions.

GROUNDWATER: The body of water that is retained in the saturated zone which tends to move by hydraulic gradient to lower levels.

HAZARDOUS SUBCATEGORY: For the purposes of this guideline, Hazardous Subcategory refers to all landfills regulated under Subtitle C of RCRA.

HAZARDOUS WASTE: Any waste, including wastewater, defined as hazardous under RCRA, TSCA, or any State law.

INACTIVE: A facility or portion thereof that is currently not treating, disposing, or recycling/recovering wastes.

INDIRECT DISCHARGER: A facility that discharges or may discharge wastewaters into a publicly-owned treatment works (POTW).

INTRA-COMPANY: A facility that treats, disposes, or recycles/recovers wastes generated by off-site facilities under the same corporate ownership. The facility may also treat on-site generated wastes. If any waste from other facilities <u>not</u> under the same corporate ownership is accepted for a fee, the facility is considered commercial.

LANDFILL: An area of land or an excavation in which wastes are placed for permanent disposal, that is not a land application or land treatment unit, surface impoundment, underground injection well, waste pile, salt dome formation, a salt bed formation, an underground mine or a cave.

LANDFILL GENERATED WASTEWATERS: Wastewater generated by landfill activities and collected for treatment, discharge or reuse, include: leachate, contaminated groundwater, storm water runoff, landfill gas condensate, truck/equipment washwater, drained free liquids, floor washings, and recovering pumping wells.

LEACHATE: Leachate is a liquid that has passed through or emerged from solid waste and contains soluble, suspended, or miscible materials removed from such waste. Leachate is typically collected from a liner system above which waste is placed for disposal. Leachate may also be collected through the use of slurry walls, trenches or other containment systems.

LEACHATE COLLECTION SYSTEM: The purpose of a leachate collection system is to collect leachate for treatment or alternative disposal and to reduce the depths of leachate buildup or level of saturation over the low permeability liner.

LINER: The liner is a low permeability material or combination of materials placed at the base of a landfill to reduce the discharge to the underlying or surrounding hydrogeologic environment. The liner is designed as a barrier to intercept leachate and to direct it to a leachate collection .

LONG-TERM AVERAGE (LTA): For purposes of the effluent guidelines, average pollutant levels achieved over a period of time by a facility, subcategory, or technology option. LTAs were used in developing the limitations and standards in the proposed landfill regulation.

NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT: A permit to discharge wastewater into waters of the United States issued under the National Pollutant Discharge Elimination system, authorized by Section 402 of the CWA.

NEW SOURCE: As defined in 40 CFR 122.2, 122.29, and 403.3 (k), a new source is any building, structure, facility, or installation from which there is or may be a discharge of pollutants, the construction of which commenced (1) for purposes of compliance with New Source Performance Standards (NSPS), after the promulgation of such standards being proposed today under CWA section 306; or (2) for the purposes of compliance with Pretreatment Standards for New Sources (PSNS), after the publication of proposed standards under CWA section 307 (c), if such standards are thereafter promulgated in accordance with that section.

NON-CONVENTIONAL POLLUTANTS: Pollutants that are neither conventional pollutants nor priority pollutants listed at 40 CFR Part 401.

NON-HAZARDOUS SUBCATEGORY: For the purposes of this report, Non-Hazardous Subcategory refers to all landfills regulated under Subtitle D of RCRA.

NON-WATER QUALITY ENVIRONMENTAL IMPACT: Deleterious aspects of control and treatment technologies applicable to point source category wastes, including, but not limited to air pollution, noise, radiation, sludge and solid waste generation, and energy usage.

NSPS: New Source Performance Standards, applicable to new sources of direct dischargers whose construction is begun after the publication of the proposed effluent regulations under CWA section 306.

OCPSF: Organic chemicals, plastics, and synthetic fibers manufacturing point source category. (40 CFR Part 414).

OFF-SITE: Outside the boundaries of a facility.

ON-SITE: The same or geographically contiguous property, which may be divided by a public or private right-of-way, provided the entrance and exit between the properties is at a crossroads intersection, and access is by crossing as opposed to going along the right-of-way. Non-contiguous properties owned by the same company or locality but connected by a right-of-way, which it controls, and to which the public does not have access, is also considered on-site property.

PASS THROUGH: A pollutant is determined to "pass through" a POTW when the average percentage removed by an efficiently operated POTW is less than the percentage removed by the industry's direct dischargers that are using the BAT technology.

POINT SOURCE: Any discernable, confined, and discrete conveyance from which pollutants are or may be discharged.

POLLUTANTS OF INTEREST: Pollutants commonly found in landfill generated wastewaters. For the purposes of this report, a pollutant of interest is a pollutant that is detected three or more times above a treatable level at a landfill, and must be present at more than one facility.

PRIORITY POLLUTANT: One hundred twenty-six compounds that are a subset of the 65 toxic pollutants and classes of pollutants outlined in Section 307 of the CWA. The priority pollutants are specified in the NRDC settlement agreement (Natural Resources Defense Council et al v. Train, 8 E.R.C. 2120 [D.D.C. 1976], modified 12 E.R.C. 1833 [D.D.C. 1979]).

PSES: Pretreatment standards for existing sources of indirect discharges, under Sec. 307(b) of the CWA.

PSNS: Pretreatment standards for new sources of indirect discharges, applicable to new sources whose construction has begun after the publication of proposed standards under CWA section 307 (c), if such standards are thereafter promulgated in accordance with that section.

PUBLICLY OWNED TREATMENT WORKS (POTW): Any device or system, owned by a state or municipality, used in the treatment (including recycling and reclamation) of municipal sewage or industrial wastes of a liquid nature that is owned by a state or municipality. This includes sewers, pipes, or other conveyances only if they convey wastewater to a POTW providing treatment (40 CFR 122.2).

RCRA: The Resource Conservation and Recovery Act of 1976 (RCRA) (42 U.S.C. Section 6901 et seq.), which regulates the generation, treatment, storage, disposal, or recycling of solid and hazardous wastes.

SUBTITLE C LANDFILL: A landfill permitted to accept hazardous wastes under Sections 3001 and 3019 of RCRA and the regulations promulgated pursuant to these sections, including 40 CFR Parts 260 through 272.

SUBTITLE D LANDFILL: A landfill permitted to accept only non-hazardous wastes under Sections 4001 through 4010 of RCRA and the regulations promulgated pursuant to these sections, including 40 CFR Parts 257 and 258.

SURFACE IMPOUNDMENT: A natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials (although it may be lined with man-made materials), used to temporarily or permanently treat, store, or dispose of waste, usually in the liquid form. Surface impoundments do not include areas constructed to hold containers of wastes. Other common names for surface impoundments include ponds, pits, lagoons, finishing ponds, settling ponds, surge ponds, seepage ponds, and clarification ponds.

TOXIC POLLUTANTS: Pollutants declared "toxic" under Section 307(a)(1) of the Clean Water Act.

TRUCK/EQUIPMENT WASHWATER: Wastewater generated during either truck or equipment washes at the landfill. During routine maintenance or repair operations, trucks and/or equipment used within the landfill (e.g., loaders, compactors, or dump trucks) are washed and the resultant washwaters are collected for treatment.

VARIABILITY FACTOR: The daily variability factor is the ratio of the estimated 99th percentile of the distribution of daily values divided by the expected value, median or mean, of the distribution of the daily data. The monthly variability factor is the estimated 95th percentile of the distribution of the monthly averages of the data divided by the expected value of the monthly averages.

ZERO DISCHARGE: No discharge of pollutants to waters of the United States or to a POTW. Also included in this definition are alternative discharge or disposal of pollutants by way of evaporation, deep-well injection, off-site transfer, and land application

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